Why We Have Automobile Accidents

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Why We Have Automobile Accidents

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To Thomas H. MacDonald
United States Commissioner of Public Roads

AND

his able associate, Herbert S. Fairbank
Chief of the Division of Information
United States Public Roads Administration

WHOSE RESEARCH AND PLANNING ARE PROVIDING AMERICA WITH A UNIFIED HIGHWAY SYSTEM DESIGNED TO MEET THE DEMANDS OF THE FUTURE

PREFACE

America is a country so rich in human and material resources, so bountifully supplied with reserves of raw materials and surpluses of goods, that we have been inclined to be wasteful and extravagant. Except in a few fields, we have not been accustomed to practice thrift and conservation on a national scale. An outstanding example of this characteristic is our indifference toward the waste of life and property from automobile accidents.

Considering the ever increasing magnitude of these losses and their enhanced importance now in terms of loss of man-hours in production and of manpower in our fighting services, we might expect to find a growing appreciation of the need for solving the accident problem. But on the contrary there is a tendency today to relegate highway safety to the limbo of non-essential activities. The reason, seldom openly expressed, which underlies this attitude is: "Transportation of men and materials by motor vehicles has always involved dangers and losses. In war time we must be prepared to pay the price, however high it may be." Those who have taken this attitude apparently have failed to realize that automobile accidents result primarily from human inefficiencies which, when they are removed, tend to speed up transportation, and that safer transportation would inevitably result in the more efficient functioning of our military machine as well as of our industrial organization.

Another indication of our indifference toward the automobile casualty problem is the scarcity of organized information on the subject. Outside of a few specialized technical books, mostly on the engineering and enforcement phases of safety, some elementary instruction manuals, an assortment of undigested statistics, and a considerable amount of twaddle, there is a glaring deficiency of literature on either the theory or the practice of accident control. We have hardly begun the task of building up a science of automobile accident prevention.

Although the amount of available accredited knowledge about highway accidents is paltry, it should nevertheless be pointed out that certain phases of the problem at least have been of concern to a variety of different groups. Thus army officers are vitally interested in having military vehicles reach their objectives; automobile insurance officials, in reducing the number and cost of claims; vehicle fleet supervisors, in cheaper and faster transportation; psychologists, in tests of driving skill; highway and

traffic engineers, in the influence of signs, signals, volume of traffic, and road design on accidents; automotive engineers, in the design of the vehicle; safety council leaders, in newspaper and radio safety propaganda; legislators, in passing restrictive laws; educators, in driver instruction and training; police officials, in enforcing the laws on the highways; and motor vehicle administrators, in regulating drivers through the authority to issue and suspend licenses. But most of these specialists devote little of their time to accident prevention. With them it is nearly always a side line of some bread-and-butter activity often only remotely associated with safety. Further, many of these specialists can appreciate only one solution to accidents—their own—and consequently seldom collaborate with others interested in the problem.

Our state motor vehicle, police, and highway departments have assumed part-time responsibilities for dealing with limited aspects of the automobile accident problem. These departments have insufficient funds for preventive safety activities, and, devoting themselves unreservedly to their specialties, they sometimes fail to understand the value of each other's efforts and of the need for a united front.

As for our communities and our country as a whole, we have been disposed to leave highway accident prevention to private enterprise or to charity. Great credit is due those private and volunteer organizations which have labored unselfishly for highway safety. But it is time that we as a nation grew out of the idea that automobile accident prevention should, like industrial safety, be left to private enterprise, or, like disasters resulting from acts of God, be left to private charity supported by drives. Rather we should consider highway safety as much a public responsibility as wild life and forest conservation, pest control, and the eradication of communicable diseases. And just as we publicly sustain these latter activities, so we should assign to highway accident prevention the services of full-time, properly trained public servants, with adequate funds and facilities at their disposal to study the perplexing problems involved.

We must admit that by and large we have been muddling along in our efforts at curbing highway accidents, floundering in search of little remedies for large troubles, instead of giving the problem the serious attention it deserves. In place of emotional appeals and scattered efforts through what we have been labeling the three E's (Engineering, Enforcement, and Education), we need to incorporate accident prevention as a unified activity in the framework of our national, state, and local governments, for highway accident prevention, although it has many phases, is essentially a single problem—deserving of full-time attention—which can

be solved most economically and effectively by an intelligently planned unitary attack.

I have attempted in this book to outline the various phases of the highway safety problem, to assess their relative significance, and to offer the reader a bird's-eye view of the field. It is to be hoped that motorists may thereby be afforded an understanding of many of the important but little-known facts about highway accidents, together with a survey of methods of preventing accidents, and that the various authorities concerned will be given a better appreciation of the problem as a whole.

Throughout the book I have emphasized the paramount importance of the driver. Some may ascribe this to bias resulting from my training as a psychologist. I cannot help but feel, however, that any serious student of the whole field would take the same attitude regardless of his previous training. A major reduction in accidents inevitably depends on driver improvement. We continually improve the design of new motor cars and roads to order and in the same way, if we apply the full resources of our intelligence, we can implant in drivers new and more suitable modes of behavior.

HARRY R. DESILVA

ACKNOWLEDGMENTS

Although I owe much of whatever is good herein to my friends and co-workers, at the risk of offending some I have presumed to criticize the status quo. My reason is that an appraisal of safety activities, however faulty in detail, seems clearly to be needed at the present stage of development of highway accident prevention. And having undertaken this task it has seemed desirable to strive to break through the respect for "things as they are" which ordinarily tends to shackle frankness. In my efforts to present a picture of "things as they ought to be" I have not hesitated, therefore, to indicate how and why accident prevention operates naïvely and inefficiently. Nor have I restrained myself from recommending that a central authority take over the responsibility for remoulding safety activities along more effective lines.

Realizing that ordinarily there is a considerable delay between discovering facts and getting them applied, or developing a plan and putting it into practice, I ventured beyond the academic cloisters a few years ago and associated myself with public officials who have authority to direct and control drivers. Since 1938, with the formation of the Driver Research Center at Yale, my outside activities have been guided by an Advisory Committee representing the American Association of Motor Vehicle Administrators, and composed of Commissioners Carroll E. Mealey of New York, Arthur W. Magee of New Jersey, Michael A. Connor of Connecticut, Murdock A. Campbell of Vermont, Wilfred A. Paquin of Rhode Island, and two successive Executive Directors of the Association, Louis R. Morony and Leland S. Harris. To these men and Mark A. May, Director of the Institute of Human Relations, Yale University, I am deeply indebted for advice in the conduct of the research. From their rich experience I have borrowed freely. Mirrored in this book they will find many of their doctrines.

I have during the preparation of this book seen little of my friend Robbins B. Stoeckel, on account of his retirement from active interest in this field. But although he may be unaware of it, I have tried earnestly to reflect his progressive ideas imparted to me in long conversations in previous years. I should also like to acknowledge the stimulating influence on my thought of other leaders in the field of motor vehicle administration, namely, Secretary of State Earl Snell of Oregon, Registrar

of Motor Vehicles Frank A. Goodwin of Massachusetts, and former Director of Motor Vehicles Ray Ingels of California.

May I also express my gratitude for the support given the Yale Driver Research Center by the Esso Safety Foundation and the U. S. Public Roads Administration for the carrying out of certain projects. I am particularly indebted to the late J. A. Donan, to T. L. Preble, A. J. Schamehorn, T. C. Smith, C. B. Veal, and J. F. Winchester for their encouragement.

My patient assistants, Willis H. Frisbee, Jr., and Phillip Robinson, have aided me in ferreting out the widely scattered facts presented in the book and assisted in preparing the tables and reading the manuscript. My secretary, Edna Cyr, has done yeoman service on the numerous copies preparatory to the final one. And my wife, Sara Thompson DeSilva, has rendered constant and painstaking service from the beginning in making the manuscript readable.

I also desire to express my appreciation to the following persons who have read and criticized one or more chapters: S. A. Abercrombie, W. G. Elliott, Jr., H. E. Hilts, E. H. Holmes, J. O. Riley, and W. J. Simon. To F. L. Jones and G. W. Allport I am grateful for valuable comments on the economic and psychological implications of my general approach to the problem.

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INTRODUCTION

We Americans resist encroachments on our freedom to drive automobiles as we please just as we resent restrictions on our freedom to worship or to vote. As a nation we dislike regimentation of any sort. Time and time again we have demonstrated that we will not readily relinquish what we regard as our individual rights unless we are convinced that our doing so is necessary for the national welfare.

Officials in charge of highway accident prevention can therefore rest assured that they will never make the progress in accident reduction that their efforts give them the right to expect, until the public understands and agrees with what they are trying to accomplish.

At present the American people do not stand wholeheartedly and unitedly behind efforts to make our highways safer. The reasons for this apathy and for our lack of systematic progress in halting highway accidents are not difficult to find. They are:

1. Repression of thinking and feeling about accidents.
2. Defeatism and ignorance.
3. Confusion of safety promotion with actual safety progress.
4. Insufficient appreciation of the human element in accidents.
5. Inadequate funds for research and planning and lack of appreciation of their need.
6. Lack of a public organization to coordinate federal-state highway safety activities.

Human beings normally possess the tendency of all organisms to struggle for survival, not against it. Thus no one in his right senses tries to be killed or injured while driving. Yet each year hundreds of thousands of Americans are physically incapacitated to a greater or less extent in highway accidents. Nobody in his right mind presumably likes to smash up his car. Yet annually the loss in wrecked cars runs into millions of dollars. In the case of these continuously repeated accidents, something must be perverting our normal human behavior. What is it?

One factor may be our human tendency to forget the unpleasant. Drivers and pedestrians alike tend to repress the distasteful remembrances of automobile accidents they have seen, or in which they have taken part. This repression removes from their minds the inhibiting, restraining influences which memory would exert over their actions and allows

them to conduct themselves as though their foolhardy behavior would have no untoward results. This habit of repression seems to carry over into our community, state, and national attitudes toward accidents and to lead us to sidestep our common responsibility for dealing with the problem. We pass a few laws, we encourage occasional face-saving safety campaigns, but we never really come face-to-face with the adversary.

In addition to this unwitting repression of the problem a number of other factors may be blamed for the size of the recurring highway casualty list. Thus our inability to reduce highway accidents consistently and uniformly throughout the country (see Chapters VII and VIII), plus a multitude of groundless opinions about the causes of accidents and resulting unsound proposals for solving the accident problem, have befuddled the driving public, giving them the impression that highway accidents are the inevitable price we have to pay for the benefits of low-cost private transportation. To offset this attitude of uninformed pessimism, we need by means of appropriate research and fact-gathering to demonstrate to the public how accidents can be decreased, and by means of lasting reduction under a wide variety of conditions to convince it that intelligent planning pays for itself in highway accident prevention just as it does in other spheres of endeavor.

All too often progress in highway safety is confused with the number of safety organizations in operation; the amount of money expended by them; the publicity given to safety propaganda in number of radio hours, inches of newspaper columns, thousands of pamphlets and posters distributed; or the passage of restrictive laws, helpful though all these may be. Actual accident reduction can be objectively gauged, and we should never permit the aura of publicity surrounding popular safety activities to divert our attention from the actual increase or decrease in the numbers of accidents, or the accident rates themselves, which alone are the true indicators of safety progress.

Although our present roads have not been designed primarily from the safety point of view, they can be driven on with impunity. The automobile, also, in most respects a safe piece of machinery, can be used with a minimum of danger. It is the driver to whom we must impute responsibility for the hazards presented by these instruments. Left gloriously free, free to follow his own inclinations, be they good or bad, he has been driving much as he pleased. And year by year he has managed to kill and injure his fellow men by the hundreds of thousands. Why? Because of wilful human faults—selfishness, lack of appreciation of his responsibilities to others, carelessness, wastefulness; because of lack of driving skill, because of unwillingness to conform to reasonable driving regulations. The driver is in need of a thorough overhauling. In place

of his present casual education and lax control we need efficient public driver training and examining and effective and coordinated enforcement of suitable driver laws and regulations by all the state motor vehicle departments.

It would be difficult to find another field of such practical importance to millions as the improvement and control of the habits of those using our highways, in which so little systematic research has been attempted, so few needed facts gathered, so little analysis made of them, and so little accomplished. And yet real progress in accident reduction demands organized fact collecting, analysis, planning, and practical application of findings no less than does advancement in other fields. We need to obtain complete and accurate data about the occurrence of automobile accidents in each state, to analyze and assemble this information in easily understandable form, and, by the study of such facts plus further scientific research, to determine the most effective and economical means of reducing accidents in different localities. We must work out long-range comprehensive safety programs for the nation, the states and individual communities, and we must secure and maintain the enthusiastic cooperation of public officials and, through them, of the public in their promotion.

What is holding up such a program? Primarily lack of funds for the purpose. From where should the money come? Unquestionably from public appropriations, since the benefits will accrue to everyone. It is to be hoped that the stimulus for improving the efficiency of transportation engendered by the war may result in the federal government assuming the responsibility—which it has long neglected—for leadership in highway accident prevention planning. American automobile, petroleum, and insurance interests, in consideration of the loss to their businesses of the 40,000 customers who are killed annually and the hundreds of thousands who are laid up from injuries, would serve their own interests as well as those of the public if they would aid in laying the foundation and organizing support for such a federal program.

If American drivers wanted accident-free highways badly enough, if they understood the means whereby accidents could be prevented and were willing to make a few of the necessary sacrifices, then we could eliminate accidents in short order. By continuing to ignore and repress the subject we continue to waste precious lives and material. If we would only call the accident problem up out of our national subconsciousness, view it realistically, and accept the necessity of spending on its treatment sufficient public funds, we could easily eradicate it. To show the American people that their national welfare demands accident-free highways, to formulate an effective plan for achieving this condition, and to produce proof of the overwhelming advantages of reasonable control

measures, we need a permanent national highway accident prevention research and planning agency. This agency, publicly supported, should work in close cooperation with the federal and state authorities at present connected with highway accident prevention work. Only through the leadership of some firmly established and independent federal organization lies much hope of improving the science of accident prevention and of gaining the necessary public support to apply it successfully in our democratic society.

In this book we shall cover the automobile accident problem from a number of different aspects, discussing causes of accidents, pointing out the present status of accident prevention measures, and indicating what direction more effective steps would take.

Chapter I will summarize the change in motor transportation during the past forty years which has resulted in our present highway accident problem.

The four most important factors which affect a person's chances of incurring accidents, namely, exposure, driving speed, driving skill, and safety-mindedness, will be analyzed in Chapters II, III, IV, and V.

In Chapter VI the need for more complete reporting of accidents will be emphasized, and the defects in our present state accident reporting systems noted. Chapter VII will outline and criticize the various methods of measuring highway safety and Chapter VIII will concern itself with neglected geographical, economic, climatic, and sociological factors which influence highway safety in different parts of our country.

The accident-repeater driver and the pedestrian will be scrutinized in Chapters IX and X.

Chapters XI and XII will have to do with the ways in which vehicles and roads can be improved to fit them better to be used safely.

In Chapter XIII the training and examining of drivers before licensing them will be discussed, whereas in Chapter XIV the means of controlling drivers after they are licensed will be taken up.

The various present-day national, state, and community safety programs will be inspected in Chapter XV.

The concluding Chapter XVI will outline a proposed highway accident prevention research and planning program designed to take the guesswork out of safety activities by furnishing the facts necessary for a systematic and effective attack on the problem.

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CHAPTER I

THE DEVELOPMENT OF OUR NATIONAL HIGHWAY ACCIDENT PROBLEM

GROWTH IN THE USE OF THE MOTOR CAR

Automobiles were first produced for sale in the United States at the beginning of this century. In forty years their use has multiplied until there are now in this country approximately 30,000,000 motor cars, or 68 per cent of the world's total. Instead of the short distances of hard-surfaced roads available in 1900 we now have 500,000 miles of paved roads and 1,300,000 miles of improved highways. Forty million drivers are using our cars and roads, or one out of every two inhabitants of the country who are old enough to drive. Of the total passenger mileage in the United States, 94 per cent is automobile travel-miles. [197, *177*]

In recognition of the advantages of motor vehicle transportation we have met and solved many problems to make possible this widespread use of the motor car. Our manufacturers have hurdled both technical and cost barriers to make the benefits of rapid motor travel available to practically all classes of our population. But although we as a country have gained the convenience of cheap and easy motor transportation, this has not been an unmixed blessing, for with the common use of the motor car has arisen a menace of the gravest public concern—*the automobile accident.*

The United States has the greatest and most costly automobile accident problem in the world, a problem which, although its casualty lists are constantly before them, most Americans do not yet appreciate. In 1941 our use of automobiles cost us approximately 40,000 lives, over 1,000,000 personal injury accidents, and uncounted millions of dollars' worth of property damage. This national problem has come upon us so suddenly and grown so rapidly that in spite of our spasmodic efforts to control it, we have not made much impression on it. If we disregard the humanitarian aspects of the situation and take a purely economic point of view, it is time we put an end to this needless waste of our resources.

Let us see how our automobile accident problem arose. At the beginning of the century motor cars presented no particular difficulty to society. There were only a few thousands of them and only a comparable number of men with sufficient temerity to operate them. Moreover, the

persons who drove motor vehicles in those days were of a different type from those who drive today. So also were the cars and the roads different.

CHANGE IN THE TYPE OF DRIVER

The small group of pioneer drivers was made up of a select number of mature persons whose knowledge of their cars and whose skill in driving were probably superior to those possessed by the average driver today. Since vehicles were expensive, only well-to-do adults could afford them, and since they were hard to operate and not very dependable only able-bodied men ventured to use them.

Contrast these drivers with the vast army of motorists today which includes youngsters of fourteen years, women, the elderly, and many of the physically and mentally unfit. In driving ability all persons are distinctly not equal, yet today the trained and the untrained, the fit and the unfit, use our highways indiscriminately.

The proportion of non-owner-drivers, many of whom are not financially responsible, and who incur more accidents in relation to their numbers than do owner-drivers, has greatly increased (see Chapter V, page 97).

And car owners now come from a different class of society than formerly. United States Department of Commerce figures indicate that 51 per cent of present car owners have a family income of less than $1,500 a year; 69 per cent of them earn $2,000 a year or less; and 87 per cent, $3,000 per year or less. [239, *15*]

As a nation the United States spends a greater proportion of its income on automobiles than any other country. Many make sacrifices in their living standards to purchase and maintain cars. Such low-income owners often cannot afford or, unless forced to do so by governmental regulation, will not pay the price to keep their cars in safe operating condition. They have a careless and irresponsible attitude toward their vehicles, which, usually out-of-date and more or less dilapidated, do not promote any pride of ownership. When to this is added the fact that such owners are usually not financially able to pay for any damage they may inflict, the vicious circle is complete.

With the wider use of the motor car has also come an increase in the number of drivers who, while intoxicated, operate their cars. Their accidents are constantly on the increase.

CHANGE IN THE CAR

Not only has the type of driver changed in the last four decades, but so also has the vehicle he runs. A generation ago, automobiles were rela-

tively scarce. Expensive to buy and troublesome to operate, they were regarded with disfavor by the conservative as risky contrivances. One could never be certain of not having to stop to change a tire or tinker

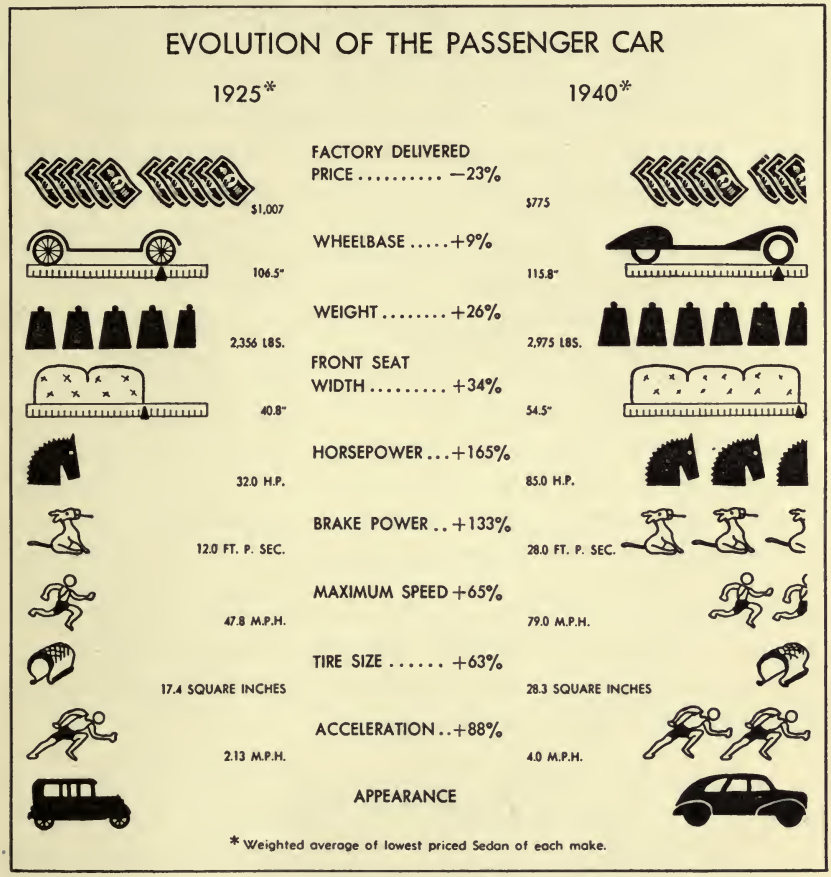


FIG. 1. Evolution of the passenger car, 1925–1940.
Source: *Automobile Facts*, Vol. II, pp. 4–5 (November, 1939). Automobile Manufacturers Association, Detroit, Mich.

with the engine during an afternoon's drive, and garages were infrequent and inefficient. Uncomfortable seats, hard tires, and rigid springs fatigued the occupants and discouraged too prolonged use—so did the bugbear of cranking the engine at each fresh start. Driving at night was unpopular and risky because of the dim oil lamps and the poorly marked roads.

Now all this is altered. The automobile, from being more or less of a curiosity, has become one of the established features of our American

civilization. Today automobiles are relatively inexpensive and dependable. Filling stations and garages are so widespread that fuel and service are procurable anywhere. Balloon tires, seats improved both in angle and cushions, better weight distribution, rubber motor mountings, and reconstructed road surfaces on which to run have made riding in a car more comfortable than sitting in many chairs at home.

The automobile has even become the American way of "keeping up with the Joneses." Each year millions of Americans change their cars to get the maximum prestige value out of the new models through which manufacturers appeal to this human foible.

The modern car is more durable and safer in construction than formerly. It goes longer without repairs and lasts better. Its brakes and lights are more effective, and its tires made of much tougher fabric seldom puncture. Instead of the open car, which left its passengers exposed to the elements, we now have the enclosed all-weather sedan, really a miniature room on wheels, provided with windows, with heat, with electric windshield wipers, and even with a cigarette lighter and radio. The present-day car is larger and roomier; it provides more space for both passengers and luggage. Americans do not take well to pint-sized cars. A big, shiny car with chromium fittings puffs up the national ego, but a miniature one deflates it.

From a safety standpoint the most important innovation of all has been in the automobile's increased horsepower, which has permitted much higher driving speeds (see Chapter III). Powerful, quiet, modern engines subtly lure us into traveling faster and faster. Streamlining has also added to possible speed by decreasing wind resistance considerably below that encountered in the old square-bodied car.

CHANGE IN THE ROADS

To meet the amazing growth in the use of automobile transportation our whole system of roads has also undergone an astounding change. When the automobile first came into use most of our roads, originally built for horse-drawn conveyances, were of dirt. Soft and rutted by the tracks of wagons and carriages, under ordinary conditions they made hard traveling, and in bad weather many of them became impassable. The few hard-surfaced roads available were narrow with no shoulders, poorly graded, and contained many potholes. Dry weather made most of the roads so dusty that car occupants had to wear dusters and veils. In winter, because of the scarcity of snow plows, the roads remained snow-covered. Such unfavorable road conditions restricted motoring to short trips at low speeds.

Today in contrast we have for the use of our motorists a great highway system 3,300,000 miles long. We now pay two and a half billion dollars annually in constructing new roads and in maintaining and improving available thoroughfares. This increase in the extent and quality of our highways has naturally brought about a wider range as well as a greater speed of travel. A trip from New York to Miami, which in 1916 was an adventurous undertaking requiring eleven days of hard driving, can now be made comfortably in three.

INCREASE IN ACCIDENTS AS A RESULT OF THESE CHANGES

The outcome of all these changes in drivers, cars, and roads has been to multiply the hazards of driving. The greater number of cars on the roads; and of unselected numbers of persons driving them; their increased mileages and speeds; their greater use under bad weather conditions and at night, when driving is less safe, have all led to more and more accidents, both those involving cars alone and those implicating pedestrians.

For generations human beings have been accustomed to relatively slow rates of travel. Now, although still endowed with nerves and muscles adjusted to slower tempos, they find themselves installed at the wheels of powerful high-speed vehicles whose potentialities often prove to be too much for them.

The automobile has been a boon, too, in that it has given us an effortless mobility which has revolutionized our way of living. As William Knudsen has so aptly expressed it, people like automobiles because "everybody wants to go from *A* to *B* sitting down." But although we Americans have adopted the automobile as necessary to our way of life and in 1940 spent 8 billion dollars operating our 30 million vehicles, we have not yet grasped clearly the character of the problems which the use of the automobile has brought with it, nor have we taken adequate steps to solve them.

NO ONE REMEDY FOR THE ACCIDENT PROBLEM

During the early stages of the development of any social problem the public is inclined to oversimplify both its causes and its possible solution. Nowhere is this tendency more manifest than in the field of highway accident prevention. For years safety "experts" have been dispensing to a credulous public varying versions of the one cause of the accident problem and its one remedy. In the absence of any scientific evidence about the real causes of accidents a variety of pet theories abound. Some of them we hear are:

Speed is at the bottom of all accidents. Cut down the speed and accidents will vanish.

Improve the highways by eliminating the four roadway frictions and eliminate the majority of the accidents.

Take the defective vehicles off the road and accidents will be drastically reduced.

Make it difficult for young people and women to obtain licenses, and watch the accidents go down.

Keep the drunks at home and solve the accident problem.

A careful study of the case histories of 892 fatal highway accidents which occurred in 1936 showed clearly that very few accidents can fairly be charged to any one act of the driver or to any one external physical condition; [236, *14*] instead, most accidents were discovered to result from a variety of contributing circumstances. In fact, an average of three important contributory factors was found for each accident.

Our accident problem is a complicated one, and, contrary to prevalent unsubstantiated opinions, cannot be resolved by any one rule. There are many factors to be taken into consideration, many points which require clarification, and many facts which need to be unearthed before we can comprehend the accident problem in all its phases and before we can plan ahead intelligently.

CHAPTER II

EXPOSURE

THE IMPORTANCE OF THE HUMAN ELEMENT IN HIGHWAY ACCIDENTS

One fact about automobile accidents on which there can be little dispute is that the *human element* is paramount. Experience has shown that no matter how clever the construction of a machine, it is the man who operates it who determines what its end result will be. The safe and efficient flow of motor transportation depends primarily on the *man at the wheel.* No matter how well-made the cars, how good the roads, or how ironclad the laws, in the last analysis it is the individual's reaction to the situations he encounters on the highway which assures safety or spells disaster.

There is a crying need for constructive control of the driver; it is the freedom accorded him which is in large part responsible for the thousands annually killed or maimed on our highways. The driver, therefore, will be the first of the factors in the highway accident problem which this book will investigate.

BASIC FACTORS INFLUENCING ACCIDENT SUSCEPTIBILITY

One of the most important questions to be asked about the driver is: "Just what determines his susceptibility to accidents?" Until we have studied this question we are in no position to formulate a constructive program to help the driver keep out of trouble.

Available information indicates that at least four factors must always be taken into consideration in determining a driver's susceptibility to accidents. First of all there is *exposure,* or the number and relative danger of the hazards which he encounters. Secondly, there is the rate of *speed* at which he is accustomed to drive. Thirdly, there is his *skill* in handling his motor vehicle. And finally, his attitude toward avoiding accidents, which we have termed *safety-mindedness,* must be considered.

The first of these factors, *exposure,* will be taken up in the present chapter. *Speed* will be discussed in Chapter III; *skill,* in Chapter IV; and *safety-mindedness,* in Chapter V.

WHAT EXPOSURE IS

Exposure in the sense in which the word is employed in this chapter refers to the number as well as to the comparative danger of the external hazards encountered while driving. Exposure may be used with reference to a single driver or to a group of drivers; for instance, those in a state, city, or commercial fleet. It is only *one* index of a driver's potential susceptibility to accidents, other factors such as the driver's appreciation of the danger of such hazards, his caution in approaching them, and the skill with which he can extricate himself from any emergency situation which may arise, play important roles in determining the actual number of accidents he incurs.

TYPES OF HAZARDS ENCOUNTERED IN DRIVING

External hazards are numerous and varied in character. Among the most important are:

1. Hazards arising from the presence of other users of the highway.
   a. Other drivers.
   b. Pedestrians and animals.
2. Hazards arising from defects in the vehicle.
3. Hazards inherent in the roadway or arising from temporary roadway conditions.
   a. Permanent features such as steep hills, sharp or irregular curves, narrow roads, soft shoulders, and intersections.
   b. Dangerous spacing and combinations of these hazards.
   c. Temporary conditions such as slippery surfaces, stationary objects, and washouts.
4. Hazards arising from poor visibility, including factors which restrict or obstruct vision.
   a. Darkness, fog, rain, and snow.
   b. Blind curves, blind hill crests, and blind intersections.

Hazards Arising from the Presence of Other Users of the Highway

Normally an increase in the number of motor vehicles on the highway leads to more chances of collision. The closer spacing of vehicles often results in more rear-end crashes. The crowding of vehicles also heightens the difficulty of faster vehicles passing slower ones, producing more head-on encounters and sideswipes. However, a point is frequently

reached in traffic where increased congestion of vehicles so lowers the prevailing speed that the chances of collision are lessened. When such a point is reached drivers who want to go faster than the prevailing speed are prevented from passing, with the net result of lessening the chances of collisions from passing maneuvers. On this subject more data as to the effect of different volumes of traffic on speed and accidents would be most welcome.

The types of drivers using the road also affect the exposure of the person who travels on it. If they are inclined to speed, or are incompetent careless drivers, his exposure to dangers will be that much more increased.

Other things being equal, pedestrians, animals, and horse-drawn vehicles make roads less safe. In densely populated regions in particular, the hazard of driving is much greater because of the danger of striking pedestrians. In regions where laws do not prohibit farmers from grazing their cattle alongside the roads, such as in the southeastern states, the possibility of hitting stray animals is high. Also, in regions where many horse-drawn vehicles use the highways, accidents resulting from attempts of faster vehicles to pass these slow-moving vehicles are common.

Hazards Arising from Defects in the Vehicle

Traffic which includes large numbers of vehicles with defective brakes and poorly adjusted headlights is less safe to drive in than traffic composed of vehicles in safe operating condition. In states with efficient vehicle inspection systems, driving is presumably safer than in states where the highways are filled with a large number of vehicles in unsafe operating condition. Unfortunately, although state and city inspection of vehicles is gaining headway, little or nothing has been done to find out how many accidents are prevented by lessening the hazards arising from defects in the vehicle, and what types of accidents they are.

Hazards Inherent in the Roadway or Arising from Temporary Roadway Conditions

The majority of accidents on main, rural highways occur on straight, level stretches of road. When the accident rates per vehicle-mile on straight, level stretches are compared with the accident rates per vehicle-mile on curves, hills, and at intersections, however, it is found that the vehicle-mile accident rates are distinctly higher on the latter. Driving, as our own experience tells us, is more dangerous on curves and hills and at intersections and railroad crossings than on straightaways. But information about the relative danger per vehicle-mile of different sections

of road is exceedingly rare. A great deal remains to be done to determine the number, as well as the relative danger, of different types of hazards inherent in the various elements of streets and highways.

Roads with ample lane widths and hard shoulders are safer to drive on than narrow roads and roads with soft shoulders. Fewer accidents involving running off the road and hitting fixed objects, should occur on a wide road, or one with proper shoulders. But since it is the tendency of most drivers to go faster on wide highways and to drive farther from the right-hand edge of the road, head-on collisions and sideswipes are sometimes actually higher on wide highways than on narrow ones. Ordinarily, however, if other conditions, including driving speeds and the amount of traffic, are equal, wide roads are safer to drive on than narrow ones.

In addition to the presence of hazards such as steep hills and sharp curves, the spacing and grouping of these hazards is a matter of considerable consequence. For example, in mountainous terrain the close proximity of a large number of bad curves and grades creates the impression of a dangerous stretch of road and encourages motorists to drive slowly and carefully. An isolated curve in an otherwise straight road, on the other hand, is usually dangerous because it is unexpected. Likewise the combination of several hazards such as a steep hill, sharp curve, and narrow road at one location is particularly perilous, especially if it occurs on a stretch of hazard-free highway.

If speed and traffic volume remain the same, an improvement in the surface of the road ordinarily makes it safer as well as easier to drive on. Loose stones or gravel, ruts and potholes, all present risks whose removal aids safety. Even for smooth-surfaced roads, however, considerable differences in the safety factor exist according to whether they are wet, icy, or covered with snow. A number of skid-resistant types of road surfaces have been developed which lessen the hazard of driving during inclement weather. These are helpful in reducing accidents except in arid regions where roads generally remain dry.

Hazards Arising from Poor Visibility

Since good visibility is an advantage in driving, any marked reduction in the amount of external illumination handicaps the driver. Since the driver is unable to see as well at night it is more dangerous to drive after dark than during the daytime. Such hazards as other vehicles, persons, or objects on the highway, as well as hills, curves, intersections, and slippery road surfaces, are especially dangerous at night. Rain, snow, or sleet, which affect visibility, also increase the exposure of those who drive under such weather conditions.

Sections of the road which do not permit a view ahead, such as blind curves, hill crests, and blind intersections, dangerous at any time, are doubly so under bad weather conditions.

INDICES OF EXPOSURE

The degree of hazard to which a driver is subjected, or, expressed differently, the extent of his exposure, is determined by *how much,* and *where,* and *when* he drives. A driver's annual mileage provides a rough indication of the number of dangers he encounters, for a motorist who covers more miles per year will normally encounter more hazards, but annual mileage itself is not a satisfactory index of a driver's exposure. We need also to know something about the conditions under which he drives. A man who travels a great deal on main rural highways takes greater risks of incurring a fatal accident than one who does most of his driving on relatively slow-speed city streets. Similarly an operator who does a larger than normal share of his driving after dark or in the winter when visibility and road surface conditions are unfavorable will be apt to face a disproportionate share of hazards. Thus *where* and *when* a man drives determine his degree of exposure just as much as does *how much* he drives.

Exposure Varies According to How Much One Drives

At the end of the year each automobile has its own different speedometer reading of miles traveled. Examination of large numbers of car owners' records discloses, however, that despite individual requirements distinct distributions of usage exist which show little variation from year to year or from state to state.

Table 1, page 12, made from returns from 77,331 car owners in Wisconsin shows the distribution of annual mileages traveled by passenger vehicles in that state in 1936. Forty-one per cent of the annual mileages fell within the range of 2,501 to 7,500 miles, and 84 per cent of the vehicles traveled 12,500 miles or less. Less than 4 per cent traveled more than 22,500 miles. The average annual mileage of the vehicles sampled was 8,131.*

Certain types of persons make far more use of their cars than do others. Table 2, page 13, is a comparison of the total mileages and round trips of cars driven annually by persons in different occupations.

* Travel of operators averages somewhat fewer miles annually than travel of vehicles, since many vehicles are driven by more than one operator.

TABLE 1

DISTRIBUTION OF ANNUAL MILEAGES TRAVELED BY PASSENGER VEHICLES
(Average annual mileage for all vehicles, 8,131, Wisconsin, 1936)

Reported Annual Mileage	Number of Vehicles	Per Cent of Vehicles
1– 2,500	12,417	16.1
2,501– 7,500	31,976	41.3
7,501–12,500	20,863	27.0
12,501–17,500	5,764	7.5
17,501–22,500	3,288	4.2
22,501–27,500	1,398	1.8
27,501–32,500	806	1.0
32,501–37,500	377	0.5
37,501–42,500	222	0.3
42,501–47,500	75	0.1
47,501–52,500	86	0.1
52,501–82,500	59	0.1

Source: Adapted from figures in *A Report on Suggested Frequency Distribution for Passenger Car Travel to Be Used in the Motor Vehicle Studies,* p. 8. U. S. Public Roads Administration, University of Wisconsin, Cooperative Agreement.

The traveling salesman's car has an average annual mileage of 18,791, or more than double the average per car of all drivers. But the average for the vehicles of medical men, lawyers, insurance and real estate men, and salesmen is also high, amounting to 50 per cent more than the average. Farmers rank lowest in annual mileage.*

The proportion of mileage devoted to necessity uses is highest among the commercial travelers—80 per cent, as compared with 49 per cent for laborers, the group using its cars least for necessity purposes. It was found that among farmers the principal necessity usage is for business trips and shopping. Wage earners, in general, travel the longest distances in reaching their jobs. The only car owner groups found driving primarily for recreational and social purposes were retired persons, widows, students, and domestic workers. [21, *19*]

An analysis of the approximate proportion of mileages and number of trips devoted to work, business, shopping, school, and recreational and social purposes in six states is presented in Table 3 at top of page 14. Driving to work and driving on business accounts for over 60 per cent of the trips and nearly 50 per cent of the mileage of all cars. Recreational and social trips, although constituting only 23 per cent of the total number of trips, account for 45 per cent of the mileage. The use of the

* The age of a car apparently has an influence on its mileage. Farmers, who drive fewest miles per year, have the oldest cars. However, whether the farmer drives less primarily because he has an older vehicle, or because of his lower economic status, or because he is busier, we have no way of telling at present.

TABLE 2

AVERAGE ANNUAL MILEAGE AND NUMBER OF TRIPS PER YEAR BY OCCUPATIONAL GROUPS

(Six states: Connecticut, Georgia, Indiana, Michigan, Nebraska, Oregon, 1936–1938)

	Average Annual Miles per Year					Average Annual Round Trips per Year				
	Necessity uses		Recreational and social		Total mileage	Necessity uses		Recreational and social		Total trips
	Miles	*Per cent*	*Miles*	*Per cent*		*Trips*	*Per cent*	*Trips*	*Per cent*	
Occupation										
Farmers	3,837	67	1,913	33	5,750	307	78	85	22	392
Laborers	3,782	49	3,875	51	7,657	385	74	135	26	520
Physicians	8,640	67	4,292	33	12,932	842	89	105	11	947
Legal profession	7,940	62	4,958	38	12,898	477	77	139	23	616
Insurance and real estate	9,063	72	3,555	28	12,618	695	86	115	14	810
Commercial travelers	15,205	81	3,586	19	18,791	528	86	83	14	611
Other sales (excludes clerks)	8,189	67	4,114	33	12,303	558	81	127	19	685
All others	4,386	51	4,264	49	8,650	447	77	136	23	583
All occupations	4,457	55	3,682	45	8,139	414	77	125	23	539

Source: *Automobile Facts and Figures,* 1941, p. 58. Automobile Manufacturers Association, Detroit, Mich.

TABLE 3

ANNUAL MILEAGES AND NUMBERS OF TRIPS BY TYPE OF PASSENGER CAR USE
(Six states: Connecticut, Georgia, Indiana, Michigan, Nebraska, Oregon, 1940–1941)

Purpose	Miles		Round Trips	
	Annual average per car	Per cent of total	Annual average per car	Per cent of total
To work	1,295	16	179	33
Business trips	2,662	32	167	30
Shopping	335	4	47	9
Hauling and to market	64	1	7	1
To school and miscellaneous	60	1	9	2
To church	63	1	13	2
Total necessity use	4,479	55	422	77
Recreational and social	3,707	45	128	23
Total all uses	8,186	100	550	100

Source: *Automobile Facts and Figures,* 1941, p. 57. Automobile Manufacturers Association, Detroit, Mich.

car for shopping and taking children to school constitutes a relatively small part of the number of trips and mileage.

At present we know practically nothing about the differences between the hazards ordinarily encountered in necessity (work and business) driving as compared with those met in recreational and social and other non-necessity types of driving. The only figures the author has ever seen on the comparative accident rate of drivers engaged in business or pleasure driving are those from Rhode Island shown in the accompanying table.

TABLE 4

PER CENT OF ACCIDENTS INCURRED BY VEHICLES ON BUSINESS, PLEASURE, AND FOR-HIRE TRIPS
(Rhode Island, 1940)

Use of Vehicle	Fatal Accidents	Non-Fatal Accidents
	Per cent	*Per cent*
For business	21.8	31.4
For pleasure	75.6	67.9
For hire	2.6	0.7

Source: *Rhode Island Traffic Accident Statistics,* 1940, p. 14. Registry of Motor Vehicles, Providence, R. I.

In it we see that motorists reporting to be driving for pleasure incurred 75 per cent of the fatal, and 67 per cent of the non-fatal accidents. We unfortunately do not know the actual proportions of business and pleasure driving of these Rhode Island operators in accidents. But if pleasure trips constitute 45 per cent of their mileage as they do for drivers in the states in Table 3, then driving for pleasure in Rhode Island is much more dangerous than driving on business. Two factors make pleasure driving more dangerous than necessity driving: in general, more of the former is done at night, on week ends, and on the more dangerous rural highways, than the latter.

This inkling of a possible difference in hazard between necessity and pleasure driving emphasizes the need for further inquiry into the matter. More information about the differences in exposure and comparative accident rates of necessity and non-necessity driving would help us to understand variations in accident rates of occupational groups, and of states where the proportions of necessity and non-necessity driving differ.

Exposure Varies According to Where One Drives

Studies made by the U. S. Public Roads Administration have shown that the majority of automobile drivers do most of their driving in the vicinity of their homes. [222, *63*] In surveys made in eleven states, it was found that 85 per cent of passenger car trips were less than 20 miles long.* Since all roads are not equally hazardous, it follows that where a motorist lives and drives is a factor which has an important bearing on the number and types of hazards he will encounter.†

Exposure of Rural and Urban Drivers. The annual mileage of the rural driver as well as the number and types of hazards he encounters vary considerably from those of the urban driver.

Differences in Rural and Urban Mileages. The accompanying table shows the variation in average annual miles per car among different residential groups. In rural areas the average is around 6,600 miles per year, as compared with approximately 7,400 miles for villages, 7,800 for small towns, 8,200 for cities under 100,000 population, and 9,000 for cities of 100,000 population and over.

* Trips of residents of urban regions were counted only when they extended beyond city limits. All trips of rural residents were counted. A trip to a point 10 miles distant and return, although requiring a total travel of 20 miles, was counted as two one-way trips of 10 miles each.

† An indication of the importance of where one lives and drives is the established policy of automobile insurance companies of charging higher rates for liability insurance to urban car owners than to rural motorists.

TABLE 5

ANNUAL VEHICLE MILEAGES ACCORDING TO OWNERS' RESIDENTIAL GROUPS
(Thirty-one states, 1936–1938)

Place of Ownership	Total Annual Mileage per Car
Unincorporated areas	6,606
Incorporated areas by population	
Less than 1,000	7,436
1,001–2,500	7,843
2,501–5,000	8,236
5,001–10,000	8,221
10,001–25,000	8,293
25,001–100,000	8,360
100,000 and over	8,994
All areas (31 states)	7,796

Source: Assembled from U. S. Public Roads Administration figures in *A Factual Survey of Automobile Usage,* Automobile Manufacturers Association, Detroit, Mich.

Two factors, the higher economic status of the city driver, and his greater proportions of out-of-state and pleasure travel, help to explain his higher annual mileage.

Residents of cities larger than 100,000 population do three-fifths of their driving on city streets, but residents of smaller cities as well as rural motorists do most of their driving on the primary rural highways. Motor vehicle operators as a whole use the main rural highways and their trans-city connections for 56.4 per cent of their travel, local city streets for 30.2 per cent, and secondary highways and local rural roads for 13.4 per cent. [222, *46*]

Although driving conditions vary in different parts of the country, there are certain hazards common to urban communities and others common to rural districts.

Rural and Urban Types of Accidents. Travel on main rural highways, on which all rural and the majority of urban motorists do most of their driving, is becoming more and more hazardous. This is indicated by the fact that during the last fifteen years, traffic deaths in rural areas and in cities of under 10,000 population have increased by 130 per cent, whereas fatalities in cities of over 10,000 population have remained practically constant. [200, *30*] Three important reasons for the better fatality record of cities as compared with that of rural districts and small towns are: (1) a proportionately greater increase in rural travel, particularly at night; (2) higher speed in rural driving; and (3) the improvement of accident control measures in cities.

The difference in hazards encountered in rural and urban areas naturally results in different types of accidents. The table below summarizes the general differences in the types of accidents occurring in urban and rural regions.

TABLE 6

COMPARISON OF TYPES OF AUTOMOBILE ACCIDENTS OCCURRING IN RURAL AND URBAN REGIONS (1939)

Type of Accident	Urban		Rural	
	Fatal	Non-fatal	Fatal	Non-fatal
	Per cent	*Per cent*	*Per cent*	*Per cent*
Pedestrian accidents at intersections	23.0	19.0	2.0	1.0
Pedestrian accidents between intersections	40.0	22.0	23.0	7.0
Two-car accidents at intersections	9.0	28.0	7.0	17.0
Two-car accidents between intersections	7.5	14.0	25.0	39.0
Non-collision accidents	9.5	5.5	31.4	26.3
Fixed object accidents	2.5	1.4	3.2	3.5
All others	8.5	10.1	8.4	6.2

Source: Adapted from *Accident Facts,* 1940 Edition, p. 91. National Safety Council, Chicago, Ill. Urban figures based on reports from 36 large cities (1939). Rural figures based on special reports from six states (1939).

The higher proportion of intersection accidents in cities results from the greater proportion of intersectional hazards encountered in driving on city streets as compared with rural highways. Approximately three out of five fatal accidents in cities and two out of five non-fatal accidents involve pedestrians, whereas in rural areas pedestrians account for only one out of every twelve non-fatal accidents. The presence of great numbers of pedestrians on city streets, of course, accounts for the higher incidence of pedestrian accidents in cities as compared with rural areas.

Other types of accidents also differ in rural and urban areas. Thus in rural regions 31 per cent of fatal accidents and 26 per cent of non-fatal accidents are of the non-collision type. The higher speed of driving on rural highways accounts for the higher proportion of these non-collision accidents, which result chiefly from overturning or running off the road. In cities, where lower speeds prevail, non-collision accidents are relatively uncommon.

Rural and Urban Deaths and Injuries. When the accident situation of a state is described in terms of fatalities alone, as is too frequently the

case, the contribution of rural areas to the accident total is apt to be overemphasized. As the table below shows, rural areas contribute heavily to the fatality toll of a state but play a much less important role when injuries are considered.

TABLE 7

DEATHS AND INJURIES FROM MOTOR VEHICLE ACCIDENTS BY POPULATION GROUPS OF RESIDENCE

(New York, 1939)

Population Group	Deaths		Injuries	
	Number	*Per cent*	*Number*	*Per cent*
New York City	841	34.6	52,200	54.4
Cities over 10,000	355	14.6	17,933	18.7
Villages and cities under 10,000	422	17.4	10,240	10.7
Rural areas	811	33.4	15,573	16.2

Source: *Annual Report of the Department of Taxation and Finance, Part III, Bureau of Motor Vehicles, 1939,* Appendix. Department of Taxation and Finance, 1940, Albany, N. Y.

The reason for these differences is easy to understand. The two most common types of motor vehicle accidents are collisions between two vehicles, and collisions between a vehicle and a pedestrian. On urban streets the presence of large numbers of vehicles and pedestrians leads to more collisions of all types, but the lower speed of city driving resulting from congestion reduces the proportion of persons killed to persons injured. On rural highways, on the other hand, where there are fewer vehicles, and hardly any pedestrians to speak of, accidents are less numerous. The absence of hazards in the country, however, invites drivers to travel at higher speeds, with the consequence that a larger proportion of the accidents result in death.

EXPOSURE VARIES ACCORDING TO WHEN ONE DRIVES

As we have stated before, the hazards encountered in driving vary not only according to *how much* and *where* a motorist drives, but also according to *when* he drives. The amount of driving he does at more dangerous times, such as at night, on week ends, and during the winter should also be considered when determining the number of hazards to which he is exposed.

Comparative Danger of Night Versus Day Driving. It is estimated that in the United States during 1939, 60 per cent of fatal automobile

accidents, or a total of 19,500, occurred during dusk or darkness as compared with 40 per cent, or 13,100, which took place during daylight hours.

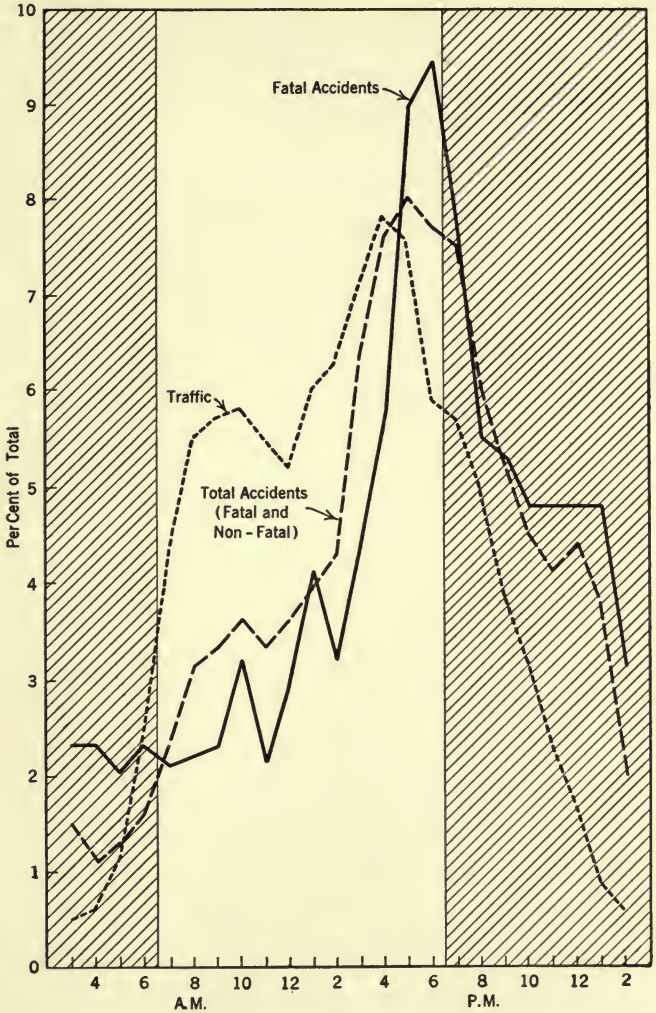


FIG. 2. Relation between volume of traffic and fatal and total accidents by hours of the day (Illinois, 1938).

Source: *Motor Vehicle Accidents*, May 1939, p. 5. Division of Highways, Springfield, Ill.

[200, *44*] The increased danger of night driving is emphasized even more when we remember that traffic on the road during the night is considerably less than during the daylight hours.

Figure 2, page 19, taken from Illinois records shows that in proportion to the prevailing traffic both fatal and non-fatal accidents were low from sunrise until late afternoon. A study of the figures upon which the chart is based shows that there were 7.7 per cent more accidents of all types, 42.7 per cent more fatal accidents, and 53.4 per cent more persons killed, during dusk and darkness than during daylight—in spite of the fact that only 30 per cent of the total traffic moved during the night hours.

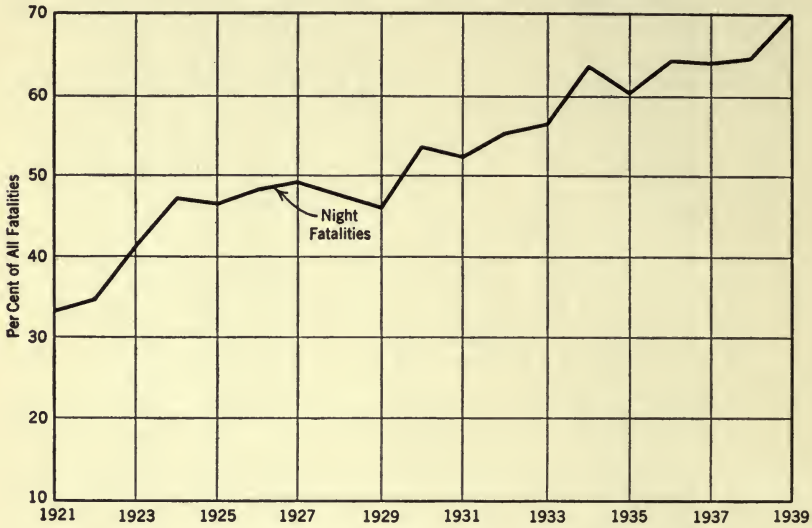


Fig. 3. Proportional growth of night fatalities compared with all highway fatalities (Massachusetts, 1921–1939).

Source: Derived from tables in *Massachusetts Fatalities; Day and Night by Months.* Registry of Motor Vehicles, Boston, Mass.

In the early days of the automobile, and during its coming of age in the 1920's, the majority of motor vehicle fatalities took place during the daytime. In recent years this situation has been reversed and night fatalities now number three out of every five traffic fatalities. The figure above gives a typical example of the change in the proportion of day and night fatalities. It shows that night fatalities in Massachusetts in 1921 numbered only 33 per cent of all highway deaths, whereas in 1939 there were more than twice as many night fatalities as there were day fatalities. Probably the two most important factors causing this change have been a disproportionate increase in the amount of night travel, as well as in the speed of such travel. Failing to realize how much his ability to see is curtailed by darkness, the average motorist does not reduce his speed

sufficiently at night. Young drivers are probably even guiltier in this respect.

Twilight is a particularly dangerous hour at which to drive. At that time the light of the sun is inadequate to see by, and yet headlights are not very effective. Twilight driving is doubly dangerous in and around cities because traffic there is heavy at that time.

Fatigue and intoxication are other factors which are important in evening and early morning accidents. The combination of fatigue and drunkenness with high speed and poor visibility makes a perfect prelude to a bad accident. The large number of drunken pedestrians walking along the highway during the night hours also adds to the night accident total. Because there is more drinking after dark, the hazard from this cause is much greater at night than in the daytime.

Night is dangerous for pedestrians, for the majority of all pedestrian deaths occur at that time. An important task of night road safety promotion, therefore, is to persuade pedestrians, especially elderly ones, to keep off the roads after sunset.

Comparative Danger of Days of the Week. Motor vehicle traffic accidents and fatalities are much more numerous on Saturdays and Sundays than on other days of the week. Until quite recently it was assumed that excessive week-end accidents were the direct result of heavy week-end travel. To a certain extent this assumption is true. Recent studies of traffic volume have indicated, however, that the increase in week-end travel does not equal the increase in week-end accidents. This finding is illustrated in Figure 4, taken from a study made by the Texas Department of Public Safety.

From Monday through Friday the daily percentage of fatal accidents is less than the daily percentage of traffic, whereas on Saturday and Sunday the percentage of accidents is approximately one-fourth more than the percentage of traffic. The fatal accident rate in terms of volume of traffic is therefore considerably higher over the week end than on weekdays.

A study made by the Colorado State-Wide Highway Planning Survey emphasizes the importance of night accidents as a factor in determining the high week-end accident rate. [52] Data developed in this report show that night traffic on rural highways in Colorado over week ends amounts to only 10.1 per cent of the total weekly travel, yet it is responsible for 23.8 per cent of the week's accidents. Week-end traffic during the daytime, amounting to 23.9 per cent of the total traffic, accounts for only 18.0 per cent of the week's accidents. It can readily be seen that the excessive week-end accident rate on Colorado's rural roads can be ac-

counted for by night accidents, which are greatly disproportionate to the amount of night travel.

The greater hazard of week-end driving is to be attributed to a variety of factors. On Saturday, urban centers are crowded with shoppers from both rural and urban areas. Not only are the streets more crowded on Saturday, but there is also a considerable increase in night traffic on that day to and from shopping and pleasure centers. Heavier drinking on

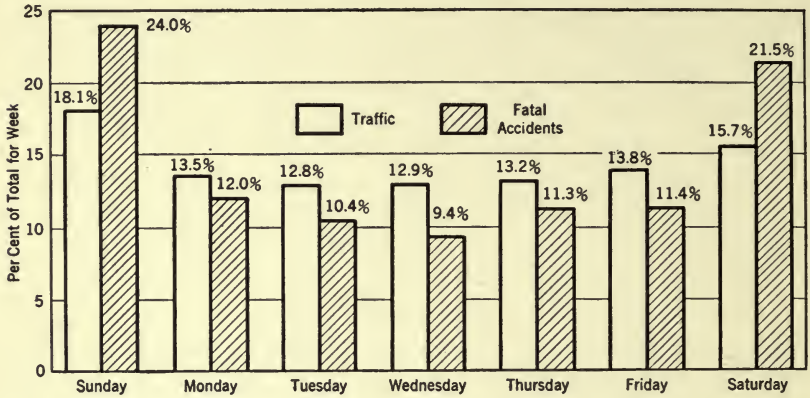


FIG. 4. Fatal traffic accidents compared with vehicle traffic by day of week (Texas, 1939).

Source: *Texas Traffic Accidents,* 1939, p. 7. Driver's License Division, Department of Public Safety, Austin, Tex.

Saturday night after workers are paid, also results in a larger number of drunken pedestrians and drivers on the highways.

The increased hazards on Sundays stem from different factors. On Sundays there appear on the roads large numbers of sightseeing motorists who do not drive much during the week and who, less experienced than weekday drivers, have to adjust themselves to unfamiliar activities. They travel at leisurely rates of speed and pay less attention to driving than the weekday motorists. Along with these slow-moving drivers, many of whom operate old vehicles, are other groups of fast Sunday drivers, those who are hurriedly returning from distant pleasure resorts, and those who are on business trips.* The presence of these two conflicting groups of fast and slow drivers has much to do with making Sunday one of the most hazardous days on which to drive.

Comparative Danger of Seasons of the Year. The availability of closed, heated cars has made travel more comfortable for winter drivers.

* One study revealed that 21 per cent of Sunday traffic is primarily non-recreational, such as business and commuter traffic. [22, 8]

This fact, together with the improvement of road surfaces and an increase in the facilities for snow removal, has augmented automobile travel during the winter time. As a consequence the proportion of winter accidents has grown, especially in those states that do a good job of clearing their highways. The following table compiled from monthly fatality figures in Massachusetts for the past twenty years shows this trend.

TABLE 8

MOTOR VEHICLE FATALITIES BY SEASONS
(Massachusetts, 1921–1940)

Period	Average for Winter Season (Dec.–Feb.)	Average for Spring Season (Mar.–May)	Average for Summer Season (June–Aug.)	Average for Fall Season (Sept.–Nov.)
1921–1925	102	128	185	215
1926–1930	138	154	207	237
1931–1935	192	166	206	250
1936–1940	174	141	159	214
Average per cent change for four five-year periods	+70.5	+10.1	−14.0	−0.4

Source: Compiled from figures furnished by the Massachusetts Registry of Motor Vehicles.

The average number of fatalities for the winter months—December, January and February—has increased 70 per cent, while that for the spring season has increased only 10 per cent, and that for the other seasons of the year has decreased.

Travel is light in the northern states during the winter months on account of inclement weather and rises with the advent of better weather during the spring and summer. As the amount of travel increases the number of fatal accidents also rises. Such accidents, however, are relatively lower during spring and summer than the amount of travel. The following figure shows this relationship clearly.

The high death rate in fall and early winter is caused by a combination of factors, such as decreased visibility and dangerous road surfaces caused by poorer winter weather conditions, and increased driving after dusk, especially during the evening rush hours. As the period of afternoon peak traffic on city streets advances more and more into the twilight, driving becomes more and more dangerous.

During the six months when hours of daylight are fewer, fatal night accidents account for approximately two-thirds of the total deaths, whereas during the six months of maximum daylight, night accident deaths make up one-half of the total. [200, *39*]

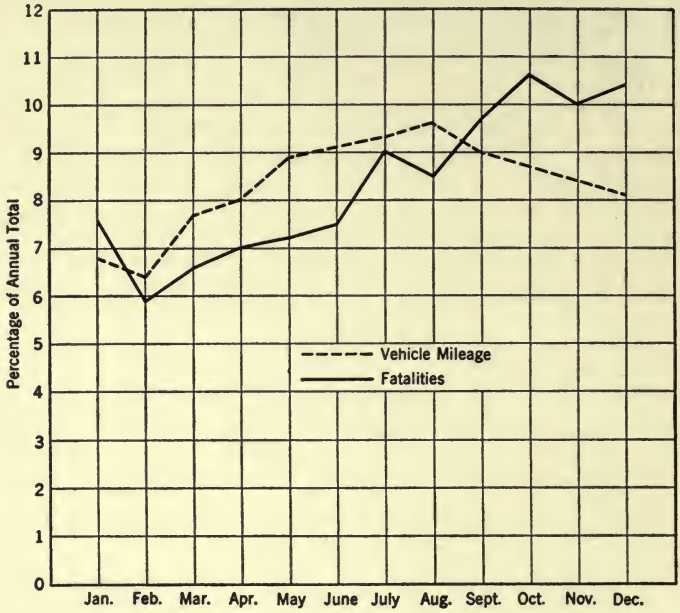


FIG. 5. Monthly variations in vehicle mileage and fatalities (United States, 1939).
Sources: Vehicle mileage data adapted from Table 623, "Highway Use of Motor Fuel by Months in 1939." U. S. Public Roads Administration. Fatality data adapted from "United States: Motor Vehicle Accident Fatalities, 1939," *Vital Statistics—Special Reports*, 11 [51], 551 (1941). Bureau of the Census, Washington.

Pedestrian deaths are likewise lowest from February through August and highest from September through January. [200, *39*] This increase during the fall and winter is to be attributed principally to the increased hours of darkness.

VARIATIONS IN THE EXPOSURE OF DIFFERENT TYPES OF DRIVERS

Much of the data on accidents of young and old drivers, men and women drivers, etc., are useless as indicators of relative accident susceptibility, since we know little or nothing about possible differences in the exposures of these types of drivers. We shall now summarize some re-

cently obtained and little-known facts about variations in the exposure of drivers according to age, experience, sex, race, and state of licensure.

Exposure of Young Versus Old Drivers

A questionnaire sent by the Connecticut Motor Vehicle Department to a large number of drivers of different ages showed that young men between the ages of 25 and 29 drive considerably more than do other age

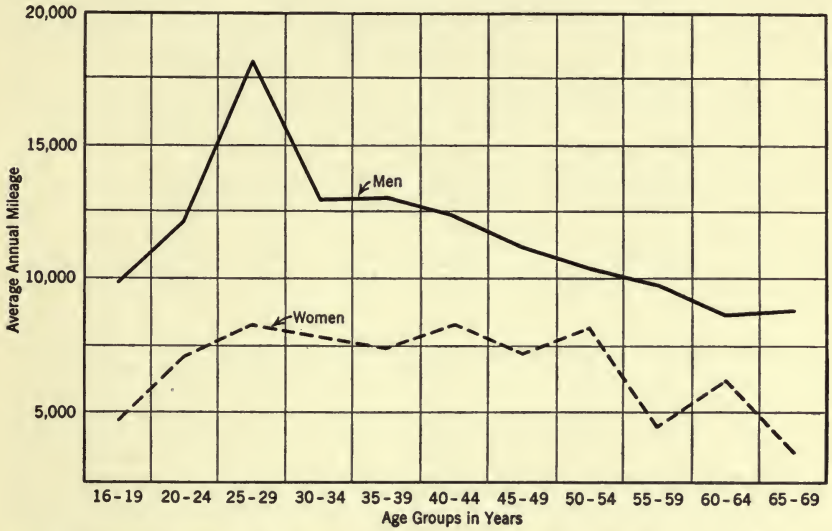


Fig. 6. Annual mileage of men and women in different age groups (Connecticut, 1938).

Source: Based on results of a questionnaire sent out to 15,000 drivers by the Connecticut Motor Vehicle Department, 1938.

groups.* Their reported *annual mileage* is almost twice as great as that of men over 55.

In a study of interests, Strong found that driving an automobile ranked very high among desired activities of 25-year-old men, of whom 88 per cent liked driving. [270, *182*] With advancing age, interest in driving decreased. At 55 years only 72 per cent of the men liked driving, and they preferred many other interests to driving. Young men not only enjoy driving automobiles more than their elders, but, as the figures above show, they actually do accumulate higher mileages.

* The higher-than-average mileages indicated on Fig. 6 may possibly be attributed to a larger-than-normal proportion of well-to-do urban drivers who answered the questionnaire.

Women drive less than men. Unlike men, their mileages tend to remain at a steady level until the age of 55, as can be seen in the figure.

The table below shows the *night and day* proportions of all accidents and fatal accidents incurred by drivers of different ages in New Jersey.

TABLE 9

PERCENTAGES OF DAY AND NIGHT ACCIDENTS INCURRED BY DRIVERS OF DIFFERENT AGE GROUPS

(New Jersey, 1939)

Age of Drivers	Total Accidents		Fatal Accidents	
	Day	Night	Day	Night
20 and under	10.5	12.2	12.4	13.3
21–29	31.0	38.8	26.3	38.3
30–49	44.7	41.0	39.2	40.3
50–64	11.9	7.3	18.3	6.8
65 and over	1.9	0.7	3.8	1.3

Source: Adapted from figures in *Thirty-Fourth Annual Report of the Commissioner of Motor Vehicles of the State of New Jersey, 1939,* table facing p. 16. Trenton, N. J.

Drivers under 21 years of age are involved in a slightly larger percentage of night than of day accidents, but their proportion of the night accident total is comparatively small (12.2 per cent). Drivers 21 to 29 years of age figure in about 31 per cent of daytime accidents, and in almost 39 per cent of night accidents; when fatal accidents are considered their night proportion exceeds their day proportion by an even greater margin. Drivers in their thirties and forties are concerned in about 41 per cent of night accidents, and 45 per cent of day accidents; their contribution to the fatal accident total is about the same during the day as during the night. After reaching the age of 50, drivers have a considerably greater share of day than of night accidents.

Another interesting point which is brought out in this study is that drivers over 50 years of age are involved in a much greater share of the daytime fatal accidents than of the less serious day accidents.

Figures from Connecticut shown in Table 10 throw further light on the question of the accidents incurred by drivers of different ages during the various periods of the day. In general, the table shows that a much greater proportion of drivers in their twenties who are involved in accidents have their accidents at night than is true of older drivers. Drivers in their twenties exceed all other groups in the proportion of their acci-

dents which occur between 6 P.M. and 6 A.M.; they have 50 per cent of their accidents during this period. With each advancing age group the proportion of accidents occurring at night grows less and less. When drivers reach their seventies less than one in five of their traffic mishaps occur between 6 P.M. and 6 A.M.

TABLE 10

PERCENTAGE DISTRIBUTION OF DRIVERS IN ACCIDENTS CLASSIFIED BY AGE OF DRIVER AND TIME OF ACCIDENT

(Connecticut, 1939)

Time of Day	Age of Drivers						
	19 and under	20–29	30–39	40–49	50–59	60–69	70 and over
6 A. M.–noon	17.1	17.7	22.2	24.7	25.2	26.1	25.2
Noon–6 P. M.	35.5	32.3	37.2	40.1	42.9	46.8	55.3
6 P. M.–midnight	36.0	33.0	29.6	27.0	26.7	24.0	17.4
Midnight–6 A. M.	11.4	17.0	11.0	8.2	5.2	3.1	2.1

Source: Adapted from figures in *Traffic Topics*, July–August, 1940. Department of Motor Vehicles, Hartford, Conn.

EXPOSURE OF EXPERIENCED VERSUS INEXPERIENCED DRIVERS

During his first year of driving the average person does not cover so many miles as he does later. Figures gathered from drivers in Connecticut indicate that a first-year driver averages approximately half as much mileage as the experienced driver. [76, *95*]

On the question of whether inexperienced drivers have more accidents per mile driven than experienced drivers there are no data. To be sure, young persons, who are naturally less experienced than older persons, have as we shall see more accidents in proportion to the number licensed, as well as in proportion to the miles they drive (see Tables 60, 61, 62). In addition to years of driving experience other differences between young and old such as exposure, attitude, and skill would also affect their accident rate. As to how important a factor experience as such really is in determining accident susceptibility will of necessity have to await future investigation.

Exposure of Men Versus Women Drivers

In Connecticut women average from 50 to 60 per cent of the annual mileage of men (see Figure 6). Young men in their twenties accumulate the highest mileages, elderly women the least. We should therefore expect that men, because of their greater exposure, would have more accidents than women, and that men from 20 to 30 years of age would incur the greater number of accidents and elderly women the least. Connecticut statistics prove this to be the case. [57]

In proportion to the numbers driving, women have fewer accidents than men. Although women comprise around 20 per cent of the licensed drivers, they are involved in from approximately 7 to 10 per cent of all reported accidents. Women get into fewer accidents than men because

TABLE 11

Percentage of Licensed Drivers, Drivers in Accidents, and Drivers in Fatal Accidents, by Sex

(Connecticut, 1938, and South Carolina, 1939)

Sex of Driver	Licensed Drivers		Drivers in All Accidents		Drivers in Fatal Accidents	
	Connecticut	South Carolina	Connecticut	South Carolina	Connecticut	South Carolina
Male	81.0	78.2	89.4	92.6	93.6	96.2
Female	19.0	21.8	10.6	7.4	6.4	3.8

Sources: Figures obtained from Connecticut Motor Vehicle Department and South Carolina State Highway Department, Traffic Engineering Division.

they are on the road less, and also because they drive under less dangerous conditions. Their driving is done principally over short distances for shopping or special errands. They are inclined not to use their cars under hazardous weather conditions or at night; and when long, hard, fast driving is called for, they let the men of the family take the wheel.

Exposure of White Versus Negro Drivers

A special study of the accident rates of negro and white drivers in South Carolina shows that negroes, who constitute about 16 per cent of the licensed drivers, furnish about the same proportion of drivers involved in accidents. [266] However, the average annual mileage reported by

negroes in a recent study in the same state was found to be considerably less than that of white drivers. [77, *703*] It would seem, therefore, that negroes do not have nearly so good a safety record per mile driven as have whites.

Exposure of Out-of-State Versus In-State Licensed Drivers

A special study by the South Carolina Highway Department showed that motorists from other states drove approximately 18 per cent of the total vehicle mileage on the state highways, and incurred 14 per cent of the accidents. [264, *40*] In other words, in South Carolina, out-of-state drivers had slightly less than their share of accidents per mile driven when compared with local drivers.

In South Carolina tourist and other out-of-state drivers travel at higher rates of speed than local drivers. [77, *705*] The probable reason why tourist drivers have a better accident record despite their higher average speeds is that they do a larger share of their motoring during the daylight hours when driving is less dangerous. An unpublished study in which the total hours of operation of motor cars with and without headlights turned on, was measured by special instruments attached to the cars, showed that the proportion of night driving, on long pleasure trips averaged only 10 per cent of the total driving, as compared with 24 per cent of night driving by stay-at-home drivers.*

Other factors which might help to account for the better accident record of tourists is that they drive newer model vehicles in better condition, and are themselves older and more experienced than in-state, non-tourist drivers. [77, *703*]

Exposure of Commercial Versus Private Drivers

The following table from a report of the Colorado State-Wide Highway Planning Survey shows the accident experience of different types of vehicles in rural and semi-urban areas of that state. Buses and trucks are seen to be less frequently involved in accidents per vehicle-mile driven than passenger cars, whereas heavy truck-trailer combinations have the highest accident rate. These figures would be more significant, however, if we knew more about the differences in the extent of day and night driving of buses, trucks, and passenger vehicles, and the types of roadway hazards encountered by them. The probable reason for the high accident rate of trucks with trailers is that, since they are more costly than smaller

* Courtesy of Val J. Roper, Nela Park Engineering Department, General Electric Company.

vehicles they are used more continuously, and are therefore on the road more after dark, on week ends, and during the winter when driving is more dangerous.

TABLE 12

AVERAGE DISTANCE DRIVEN BETWEEN ACCIDENTS BY DIFFERENT TYPE VEHICLES IN RURAL AND SEMI-URBAN AREAS

(Colorado, 1936–1938)

Type of Vehicle	Accumulated Vehicle-Miles of Travel Between Accidents
Buses	326,800
Trucks	271,743
Passenger vehicles	262,724
Trucks with trailers, and truck tractors with semi-trailers (with or without full trailers)	202,305

Source: *A Study of the Traffic Accident Experience in Colorado, 1936–1938,* p. 34. Colorado State-Wide Highway Planning Survey, Denver, Col.

The types of accidents in which interstate commercial vehicles are involved differ markedly from those accidents incurred by all vehicles.

TABLE 13

PERCENTAGE OF PERSONS KILLED AND INJURED IN ACCIDENTS INVOLVING INTERSTATE BUSES AND TRUCKS AND ALL VEHICLES, CLASSIFIED BY TYPES OF ACCIDENTS

(United States, 1939)

Type of Accident	Persons Killed			Persons Injured		
	Interstate buses [1]	Interstate trucks [1]	All vehicles [2]	Interstate buses [1]	Interstate trucks [1]	All vehicles [2]
Collision						
Pedestrian	21.1	13.8	37.7	3.3	4.5	22.6
Motor vehicle	67.6	70.3	26.5	67.0	80.6	56.5
Train	0.0	2.5	4.2	0.0	1.1	0.4
Fixed object	2.8	3.2	3.1	4.8	1.8	2.2
Non-collision	1.9	5.2	25.3	14.2	5.7	13.9
All others	6.6	5.0	3.2	10.7	6.3	4.4

Source: 1 Adapted from figures in *Motor Carrier Accidents, 1939,* pp. 66, 125. Interstate Commerce Commission, Bureau of Motor Carriers, 1940, Washington, D. C.

2 Adapted from figures in *Accident Facts,* 1940 Edition, p. 85. National Safety Council, 1940, Chicago, Ill. "All vehicles" include trucks and buses, although the great majority of registered cars are of course private passenger vehicles.

Pedestrian accidents form a much smaller proportion of interstate commercial vehicle accidents than of those involving all vehicles. Collisions with other motor vehicles, on the other hand, which form the bulk of interstate truck and bus accidents, particularly fatal accidents, are considerably less common where all vehicles are concerned. Not a single person was killed or injured in a collision between an interstate bus and a railroad train in 1939. Non-collision accidents, which caused a quarter of the deaths involving all vehicles, were relatively unimportant as causes of interstate commercial vehicle fatalities. However, this type of accident was responsible for about the same proportion of persons injured in interstate bus accidents as in those accidents involving all vehicles, although it was less important in interstate truck accidents.

THE PART PLAYED BY EXPOSURE IN ACCIDENT SUSCEPTIBILITY

In the past there has been too much of a tendency to consider exposure as determined solely by annual mileage, or how far one drives. It is true that if other things are equal, operators who drive farther than the average during the year should be exposed to more dangers. But other circumstances are seldom the same in the experience of different drivers. A driver's exposure depends on a number of factors, which include not only the number of miles covered annually, but also when and where he drives. Thus a motorist who drives much at night, or during the rush hours, or on week ends, or during the winter, or in and around metropolitan areas, is exposed to a greater number of hazards than another motorist with the same annual mileage who does most of his driving during less dangerous times or in less hazardous localities. Other factors such as age, sex, race, occupation, and experience also influence exposure.

Since a knowledge of driving exposure is basic to any study of relative accident susceptibility, it deserves much greater consideration than has been accorded it in the past. We are urgently in need of much more information about the exposure of different classes of drivers, particularly to begin with, about their average annual mileages, to aid us in analyzing better our city and state accident statistics.

We must make a much greater effort than we have in the past whenever comparing the accident rate of one state with another, one city with another, one vehicle fleet with another, passenger car drivers with truck drivers, interstate drivers with intrastate drivers, men drivers with women drivers, negro drivers with white drivers, urban drivers with rural drivers, pleasure drivers with necessity drivers, owner-drivers with non-owner-drivers, army drivers with civilian drivers, always to endeavor to allow for differences in exposure. For many of the differences between different groups of drivers and different classes of drivers can often be ascribed

more to differences in driving habits which influence their exposure, than to intrinsic differences in the drivers themselves.

Although the number and importance of hazards encountered by different drivers vary considerably, there is little excuse for a driver to try to justify continued accidents by his more dangerous exposure. The high-exposure driver should not be allowed to use the highways unless he can drive not merely as well as the average driver but better. In other words, society should expect the high-exposure driver to incur fewer accidents per mile traveled than the average motorist if he is to retain the privilege of using the highways more extensively. The knowledge that he has to drive farther and under more dangerous conditions than the average motorist, should serve to heighten a driver's sense of social responsibility and make him more alert to those hazards.

Exposure, defined in terms of various types of external hazards, is a factor contributing to accidents, but it is by no means the only determining factor. Drivers get into accidents not only because of their exposure to external hazards, but also because they are going at speeds too fast for conditions, or are not skillful enough, or are not sufficiently safety-minded. These three aspects of accident causation—speed, skill, and safety-mindedness—will be taken up in the following chapters.

CHAPTER III

SPEED

In Chapter II it was pointed out that a driver's susceptibility to accidents is influenced by his exposure, or the number and importance of the external hazards he encounters. This chapter will be devoted to an analysis of the part played by *speed* in his accidents.

Driving speed, like exposure, is controlled by external factors as well as by volition. Thus a driver's rate of travel may be influenced in part by such objective factors as the vehicle which he drives, the type of road on which he travels, the traffic he encounters, and the distance he has to go in a given time.

THE EFFECT OF IMPROVED VEHICLES AND BETTER ROADS ON OPERATING SPEEDS

The subject of speed control is a very controversial one, of which we seldom hear an unbiased discussion. Speed, of course, accounts for many of the conveniences of the private automobile. We travel in order to reach a destination. The less time we spend traveling the more time we have to enjoy ourselves or to carry out our business after we arrive, hence the high value we place on faster and faster means of transportation.

In the last ten years the average horsepower of motor vehicles has increased from 54 (in 1930) to about 90 (in 1939). During the same period the average top speed at which new vehicles can be driven has risen from 69 to 84 miles per hour (see Figure 7).

Riding on a cushioned divan encased in a soundproofed steel shell, we experience today few of the sensations of speed present in the horseless carriage of a generation ago. The play of the wind through the hair, the roar of the unmuffled motor, the jounces and jolts from the road have now been eliminated. We can drive at 60 miles per hour or faster before we begin to have any appreciable feeling of speed. This removal of the customary inhibiting impressions of speed by the improvement of highway as well as vehicle, often lulls modern drivers into a false sense of security at high speeds, and unquestionably encourages many of the drivers of our quiet smooth-riding vehicles to go too fast.

Fortunately, the majority of our drivers appear to keep to reasonable speeds. Studies made of the speeds of drivers on stretches of hard-surfaced rural highways in Connecticut and California showed that the average speed of all drivers is between 40 and 45 miles per hour. Only ½ per cent of the 60,000 vehicles timed in California were traveling in

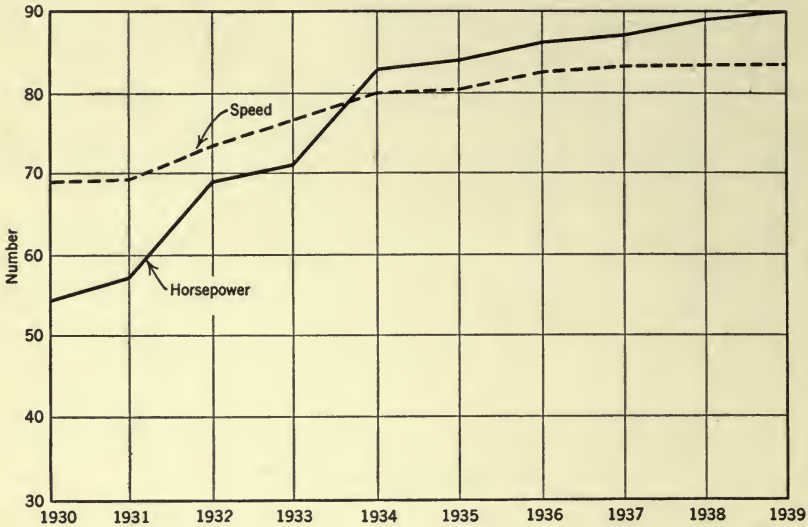


Fig. 7. Changes in automobile speed and horsepower (U. S. 1930–1939).

The data on *horsepower* represents the horsepower of the average vehicle sold. The data on *speed* represents the average top speed in miles per hour of all the cars tested at the General Motors Proving Ground in the years 1930–1939.

Source: Horsepower, for 1930–1936: W. S. James, "Engineering the Vehicle for Safety," *Trans. Nat. Safety Congress*, 26, 20 (1938); for 1937–1939: *Automotive Industries*, March, 1940, p. 194.

Speed: Data furnished by General Motors Corporation, Proving Ground Section.

excess of 65 miles per hour. Moreover, 94 per cent of them all were going 55 miles per hour or less, and almost 80 per cent, at 50 miles per hour or less. In general, therefore, it seems that only a small percentage of drivers travel at excessive speeds (see Figure 8).

Nevertheless the number of motorists traveling in the high-speed ranges is reported to be slowly but steadily increasing. In California other speed measurements made on main highways over a period of three years showed that whereas 70.4 per cent of drivers in 1935 were traveling at 45 miles per hour or under, only 63.5 per cent of drivers were traveling that slowly in 1936, and in 1937, only 59.7 per cent. [45, *68*]

Excessive speed is undeniably dangerous. A certain amount can be done to educate persons to drive safely at high speeds, but, unfortunately for theorists, there is a limit to the speed at which ordinary operators are able to drive cars safely even on superhighways. Speed cannot be in-

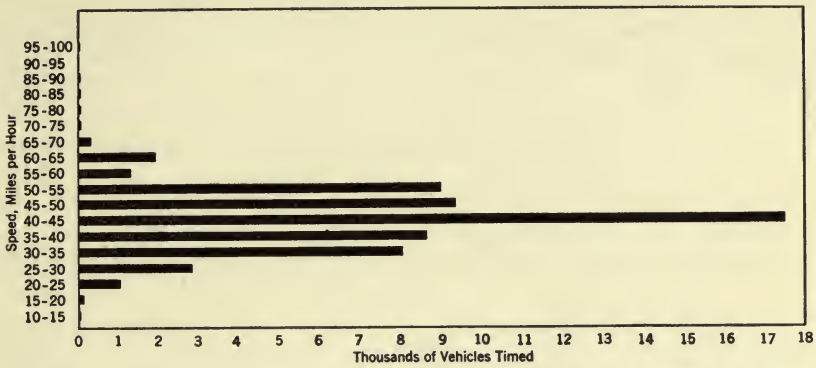


FIG. 8. Frequency of vehicle speeds classified in five-mile intervals (California, 1936). Source: *Annual Statistical Report*, 1937, p. 55. Department of Motor Vehicles, Sacramento, Calif.

creased with safety beyond the capabilities of the human element behind the wheel.

EFFECT OF SPEED ON NUMBER OF ACCIDENTS

In studying the speed problem it is important to determine the effect of speed on accident rates. Unfortunately, the answer is not a simple one. The first question to settle is: Do people who drive fast have more accidents than people who drive at moderate rates of speed?

ACCIDENTS OF HIGH-SPEED VERSUS MODERATE-SPEED DRIVERS

A study was made by the author and his associates at Yale of the relation between operators' open-road speeds and their driving records. [76] A group consisting of operators traveling over the maximum permitted speed of 50 miles per hour on main rural highways in Connecticut was compared with a group consisting of operators who were traveling from 35 to 45 miles per hour. These groups of drivers were selected in a speed survey in which it was possible to identify each driver with sufficient exactitude for an investigation of his driving record to be made.

The figure below shows that the group of drivers who were traveling over 50 miles per hour had five times as many speed violations, over

twice as many traffic violations, and 50 per cent more accidents recorded against them than the moderate-speed drivers.

In spite of the importance of speed as a factor in accidents there are few additional facts to show how an operator's accident record is influenced by his prevailing driving speed. But considerable data are available to show that rigid enforcement of speed regulations does result in reduced accident rates.*

Reduction of Accidents in Cities Through Speed Limitation

Providence, Rhode Island, is an example of a city which has reduced its accident rate by restricting driving speeds. [90] Although Providence had long been a leader in highway safety, its accident rate mounted mark-

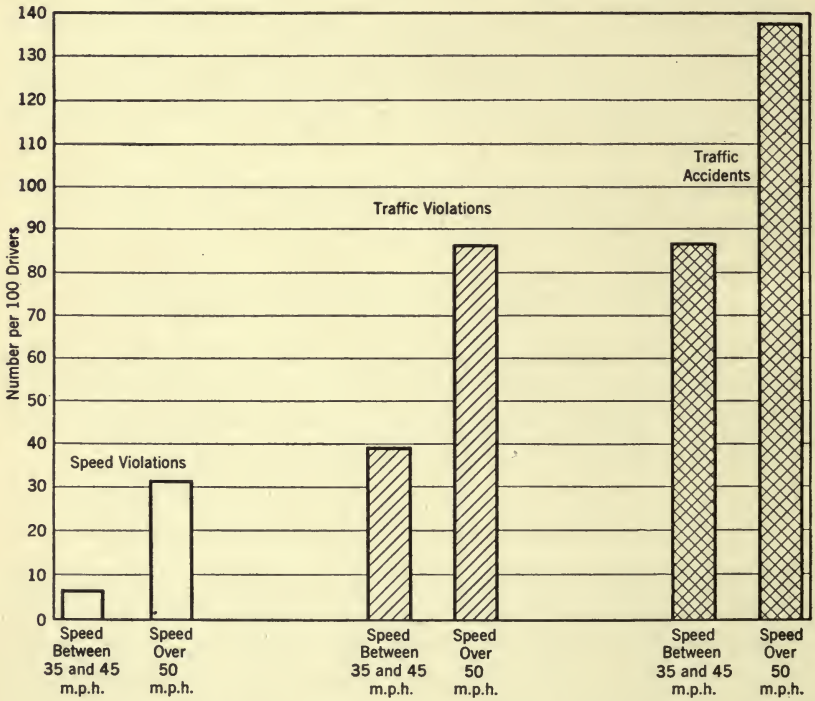


Fig. 9. Comparison of speed violations, traffic violations, and accidents of moderate and high-speed drivers (Connecticut, 1939).

Source: Harry R. DeSilva, "A Study of Motor-Vehicle Drivers and Speed in Connecticut," *Public Roads*, 21, 99 (1940).

* For an extensive review of the facts concerning speed control on rural highways, see Paustian. [224, *61–73*]

edly in 1937. To combat this a vigorous safety campaign was started late in November, 1937; the main feature was enforcement of a top speed of 25 miles per hour in the city. As a result fatalities dropped 61 per cent the following year, and personal injury accidents decreased 42 per cent. Today Providence with particularly rigid enforcement of its speed laws is one of the safest cities in the country.

Atlanta, Georgia, has also made an impressive record in reducing accidents by enforcing a 25-miles-per-hour speed law. The Atlanta Police Department started a campaign to reduce speed in December, 1938. The results of this campaign are summarized in the table below.

TABLE 14

COMPARISON OF ACCIDENTS AND ARRESTS IN ATLANTA, GEORGIA, BEFORE AND DURING THE ENFORCEMENT OF A 25-MILES-PER-HOUR SPEED LAW

Period	Accidents per Month			Arrests for Speeding per Month
	Fatal	Personal injury	Property damage	
Before enforcement (January–November, 1938)	4.1	127	381	139
During enforcement (December, 1938–December, 1939)	2.8	84	329	779

Source: Figures obtained from the Police Department, Atlanta, Ga.

Note that the fatalities and personal injuries were reduced by a third, and property damage by one-seventh after the speed law went into effect. To achieve these results more than five times as many arrests for speeding were made as in the previous year.

LIMITS TO SPEED REDUCTION

The reduction of speed as a solution to the accident problem depends upon the community and the attitude of the public. If speed limits are reduced too far below the speed at which most motorists find it convenient and comfortable to drive, it is difficult to enforce the speed law.*

* Sergeant VanBlankensteyn of the Michigan State Police points to several considerations that must be kept in mind in fixing a speed limit: (1) it must be consistent with safety; (2) it must appear to be reasonable; (3) obedience to it must not be too inconvenient; (4) at least 80 or 90 per cent of all drivers must

If the majority of the driving public disapproves of the law, the traffic police will either have to lessen their enforcement activities or the public will be inclined to restrict its use of motor vehicles. The city of Providence in putting into effect a 25-miles-per-hour day-and-night ruling has probably gone the limit in low-speed enforcement.

In America efforts at arbitrary restriction of the rights of law-abiding motorists to travel freely on the highways have usually been resisted. The issue of preserving the rights of the individual to use the highways in a reasonable manner is an important one, and cannot be dismissed lightly, but it is evident that limitations of speed suited to the locality are necessary if our highway accident rate is to be lowered. Eventually drivers will recognize this and acquiesce more gracefully in restrictions made for their own benefit.*

EFFECT OF SPEED ON THE SEVERITY OF ACCIDENTS

The faster an automobile goes the more damage it will inflict if it collides with anything.

The New Jersey Motor Vehicle Department made a study of 10,000 accidents occurring in 1936 which showed that death and high property

TABLE 15

Comparative Severity of Speeding and Non-Speeding Accidents in Urban and Rural Regions

(New Jersey, 1936)

Type of Accident	Fatal Accidents for Every 100 Non-Fatal Accidents		Percentage of Accidents in Which Over $100 Property Damage Was Reported	
	Urban	Rural	Urban	Rural
Speeding	2.4	9.1	48.3	57.2
Non-speeding	2.0	6.7	28.1	42.1

Source: Adapted from figures in *Speed and Accidents*, p. 6. Progress Report of Committee on Speed and Accidents, Street and Highway Traffic Section, National Safety Council. National Safety Council, 1937, Chicago, Ill.

find obedience to it automatic; (5) its enforcement must be practicable; (6) it must be readily understandable. [279, 22]

* It is to be hoped that studies will be made of the effect on accidents of lowering driving speeds during the war. The opportunity to gather facts on this point should not be lost.

damage resulted more often from "speeding" accidents than from "non-speeding" accidents.

The reason destructiveness increases with speed is obvious. The higher the speed the greater the energy developed, and therefore in an accident the vehicle will cause more damage both to itself and to any object it hits.

EFFECT OF SPEED ON MANEUVERABILITY

With greater speed automobiles become increasingly difficult to handle. The faster a vehicle travels the harder it is to steer around obstacles that appear in its path, or to speed up or slow down to avoid a dangerous situation.

Horizontal curves are much more dangerous for cars driven at high rates of speed. If the curve does not have a long enough radius of curvature, or sufficient banking for the speed driven, the centrifugal force generated will cause the car taking it to roll over. Figure 10 shows the approximate curves that may be taken safely on a flat, hard-surfaced road at 30 and 50 miles per hour. Because a car can be turned very little at high speed many accidents occur on curves and when passing.

The useful top speeds of modern automobiles are limited on account of this difficulty of steering safely at very high speeds. Continuous speeds much greater than 50 miles per hour are impractical for the average driver, except on a few specially built roads where curves and turns are banked, and opposing lanes of traffic are separated by medial strips. Even on the best types of superhighways available today, such as the Merritt Parkway in Connecticut, 50 miles per hour seems to be regarded as fast enough by the majority of drivers.

Further, the ability of the average car to speed up and slow down quickly is lost at speeds of 65 or 70 miles per hour, since the engine at this pace cannot give the extra power necessary for quick acceleration [38] and the brakes cannot so rapidly halt the car.

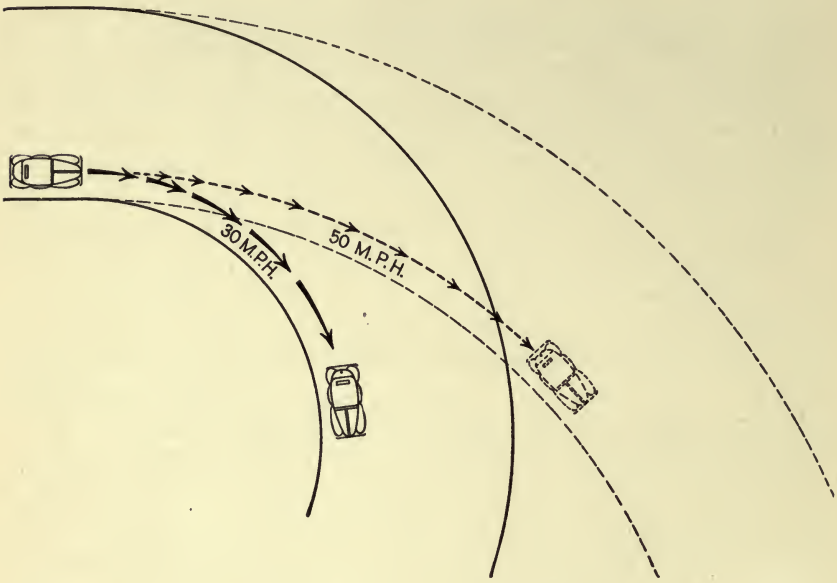
In other words, maneuverability decreases very rapidly at increased speeds. This makes the speeding car extremely difficult to handle in emergencies.

EFFECT OF SPEED ON STOPPING DISTANCE

Stopping distances depend upon three factors: (1) the driver; (2) the vehicle; and (3) the road.

The Human Factor in Stopping Distance

The efficiency of the driver's reaction in stopping a car depends on: (1) his ability to perceive an emergency and (2) his quickness of reaction.



Miles per Hour	Safe Turning Radius in Feet	Proportional Turning Ability (Approximate), Assuming 20 m. p. h. as 1
20	53.4	1
30	120.0	1/2
40	214.0	1/4
50	334.0	1/6
60	430.0	1/8
70	654.0	1/12
80	858.0	1/17

Fig. 10. Safe speeds on curves.

Source: Curves based on data in table provided by courtesy of General Motors Proving Ground, Milford, Mich.

Recognition of an Emergency. Since the faster one drives, the farther ahead one must look in order to stop one's car in time in case of emergency, a good driver avoids accidents by keeping his driving speed adjusted to the extent of safe road visible ahead of him. On nearing in-

tersections, curves, hills, or places where his sight distance is shortened, he slows down. The poor driver, in contrast, by failing to "drive ahead" multiplies the number of the emergencies he encounters.

The driver's awareness of the field of safe travel in front of him, although partly dependent on his attention and alertness, is also contingent on the keenness and accuracy of his vision. [113] Astigmatism, diminished visual acuity, and inaccurate depth perception affect his appraisal of the road and his estimation of distances and speeds. A defective eye on one side makes him less conscious of dangers on that side. Night blindness, inability to see at night, and glare blindness, inability to see in the face of glaring headlights, are other common defects which make their possessors more susceptible to accidents (see Chapter IV).

Reaction Time. "Reaction time" includes both the driver's mental reaction to an emergency and the time necessary for him to apply his brakes.

Under road conditions, when the driver has many things to attend to, reaction times of individual drivers vary from about 0.4 of a second up to 1 second. The reaction time table below shows how far drivers travel at various speeds during different reaction times. If a driver's reaction time is a minimum of 0.4 seconds, at 20 miles per hour he would travel 12 feet while reacting, and at 60 miles per hour, 35 feet, almost three times as far. If his reaction time were long, say 1 second, at 20 miles per hour he would go 29 feet, and at 60 miles per hour, 88 feet.

TABLE 16

DISTANCES TRAVELED AT DIFFERENT SPEEDS DURING VARYING DRIVER-REACTION TIMES

Reaction Time	Speed				
	20 m. p. h.	30 m. p. h.	40 m. p. h.	50 m. p. h.	60 m. p. h.
Seconds	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*
0.4	12	18	23	29	35
0.5	15	22	29	37	44
0.6	18	26	35	44	53
0.7	21	31	41	51	62
0.8	23	35	47	59	70
0.9	26	40	53	66	79
1.0	29	44	59	73	88

Effect of the Vehicle's Mechanical Condition on Stopping Distance

Automobiles whose brakes have a small braking area and poor quality linings predispose their drivers to accidents by not being able to exert sufficient retarding effect when a sudden stop is called for. But the owner's carelessness in not keeping his brakes properly adjusted and maintained is by far the most common reason for brake failure. Brakes may get out of order in several ways: (1) The brakes on the right and

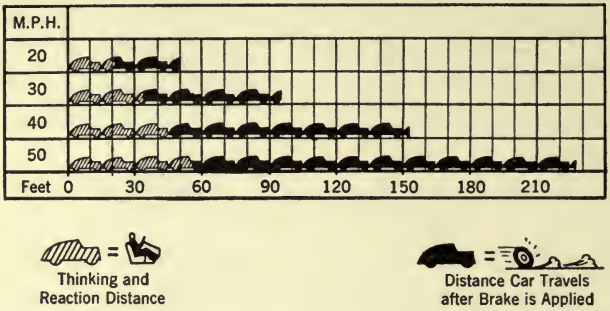


Fig. 11. Distances traveled at different speeds while the motorist is reacting and while the brakes are operating.

Source: Reaction distance based on a reaction time of three-quarters of a second. Braking distance based on figures of the National Bureau of Standards in *Manual on Uniform Traffic Control Devices for Streets and Highways*, p. 139. American Association of State Highway Officials, 1935, Washington, D. C.

left wheels may be unevenly adjusted, causing the car to swerve or skid when the brakes are applied forcefully; (2) If the front wheels are not set to exert a greater braking force than the rear, a sudden stop, which throws more weight on the front wheels, may cause the rear wheels to lock, throwing the car out of control; and (3) grease, water, or dirt may get on the brake linings, causing the brakes to slip or grab.

When the brakes are in average condition and the road favorable the approximate combined driver-reaction and vehicle-stopping distances at different rates of speed are as shown in the accompanying figure. These distances may be increased 10 to 50 per cent or more if the brakes are faultily constructed or poorly maintained.

Influence of the Type of Road on Stopping Distance

Stopping distances are affected both by the road's type of surface and its grade. When roads are slippery or covered with loose gravel, stopping

lengths may be doubled. The stopping distances on packed snow are about two and a half to four times greater than on dry concrete, and ice calls for five to eleven times as much space. [205, *29*] When going down hills, stopping distances are naturally also increased; the steeper the grade, the greater the distance necessary.

RECENT STUDIES OF FACTORS INFLUENCING DRIVING SPEED

Although speed is recognized as playing a significant part in the highway accident problem, we know little about the various factors that influence the speed of drivers. In the summer of 1939 the Yale Driver Research Center in cooperation with the American Association of Motor Vehicle Administrators, the U. S. Public Roads Administration, and the Connecticut Motor Vehicle, Police, and Highway Departments initiated in Connecticut the first of a series of investigations to throw new light on this problem. [76] Similar driver-speed investigations have since been completed in South Carolina and California although the results from the last study have not yet been published.

In these investigations, vehicle speeds were obtained with a special meter that automatically recorded the speeds at which cars were traveling. Straight sections of highway relatively free from hazards were selected. The speed meter was hidden from the sight of passing motorists. Attendants at the speed meter noted the speed and recorded the registration numbers of all vehicles passing in one direction. Out of sight of the speed meter location, these vehicles were stopped by a policeman who motioned them to the side of the road where the drivers were interviewed.

After more research is completed it is hoped that the relative importance of the various factors which influence driving speeds can be determined. At present on the basis of these preliminary investigations it seems that the two most important factors which affect driving speeds are: (1) the distance the motorist is traveling during the day; and (2) the age of his vehicle. Other factors which may influence driving speed include the number of passengers in the car and the sex of the driver.

The Relation of Trip Distance to Speed

In both the Connecticut and South Carolina studies it was found that as the trip distance lengthened, the speeds increased progressively. [77, *704*] According to the table below, motorists traveling for short distances drove at slower average speeds in South Carolina than drivers in Connecticut, but operators traveling distances over 100 miles average considerably higher speeds in South Carolina than in Connecticut.

The farther a motorist travels during the day the faster he drives. Trips of 100 miles and longer in particular increase a motorist's driving speed.

TABLE 17

AVERAGE SPEED OF DRIVERS TRAVELING VARIOUS TOTAL DISTANCES ON DAY OF STUDY
(Connecticut, 1939, and South Carolina, 1940)

Trip Length on Day of Study	Speed	
	Connecticut	South Carolina
Miles	*M. p. h.*	*M. p. h.*
19 and under	40.1	36.8
20–49	41.1	39.6
50–99	42.6	42.6
100 and over	44.6	48.9

Source: H. R. DeSilva, "Results from Speed Studies in Connecticut and South Carolina," *Proceedings of the Highway Research Board,* 20, 704 (1940).

Since drivers of out-of-state registered vehicles are usually on long journeys and are traveling farther during the day than in-state drivers, we should expect them to drive faster. The table below shows this to be true.

TABLE 18

SPEED AND TRIP LENGTH OF IN-STATE AND OUT-OF-STATE LICENSED DRIVERS
(Connecticut, 1939, and South Carolina, 1940)

State of Licensure	Speed		Trip Length on Day of Study	
	Connecticut	South Carolina	Connecticut	South Carolina
	M. p. h.	*M. p. h.*	*Miles*	*Miles*
In-state	42.5	42.0	108.5	83.4
Out-of-state	45.6	49.8	255.8	377.6

Source: H. R. DeSilva, "Results from Speed Studies in Connecticut and South Carolina," *Proceedings of the Highway Research Board,* 20, 703 (1940).

AGE OF CAR AS RELATED TO ITS SPEED

As will be seen by the table, page 45, new models are driven at higher speeds than older vehicles. An independent study of Lawshe [154, *10*]

confirms this finding. One reason is, of course, that new cars can go faster than old ones. Moreover, since new model vehicles travel more smoothly and quietly than older vehicles, motorists probably do not realize that they are driving them much faster. The greater ease with which new vehicles may be driven also encourages higher speeds.

TABLE 19

AVERAGE SPEED OF VEHICLES BY YEAR MODELS
(Connecticut, 1939, and South Carolina, 1940)

Year Model of Vehicle	Speed	
	Connecticut	South Carolina
	M. p. h.	*M. p. h.*
1929 and older	39.1	32.9
1930–1931	39.7	33.9
1932–1933	40.5	38.1
1934–1935	43.3	41.4
1936–1937	44.1	45.4
1938–1939	45.2	48.2

Source: H. R. DeSilva, "Results of Speed Studies in Connecticut and South Carolina," *Proceedings of the Highway Research Board,* 20, 705 (1940).

NUMBER OF PASSENGERS IN CAR AND SPEED

The presence of passengers seemed to have a somewhat retarding effect on the speed of drivers in Connecticut and Ohio and of in-state white drivers in South Carolina. The influence of passengers on speed was small in the case of out-of-state drivers in Connecticut, however, and it was not discernable in the case of white out-of-state drivers in South Carolina. In contrast to white drivers, negroes driving cars with passengers in them traveled faster than those without passengers (presumably to "show off"). See Table 20 on page 46.

SEX OF DRIVER AND SPEED

A prevailing opinion held by men drivers is that women drive slowly and impede the normal flow of traffic. Several investigations have proved on the contrary that on the open highway women drive at approximately the same average speed as men. [77, 275]. Studies (Table 21) show that apparently women drive at about the average speed of the traffic in which

TABLE 20

AVERAGE SPEED OF DRIVERS IN VARIOUS CLASSIFICATIONS TRAVELING WITH AND WITHOUT PASSENGERS

(Men drivers only, Connecticut, 1939, South Carolina and Ohio, 1940)

Classification of Driver	Speed	
	Without passengers	With passengers
	M. p. h.	*M. p. h.*
Connecticut in-state	46.3	42.1
Connecticut out-of-state	46.2	45.7
South Carolina white in-state	44.0	41.6
South Carolina white out-of-state	50.0	50.0
South Carolina colored in-state	33.8	37.0
South Carolina colored out-of-state	40.4	47.6
Ohio drivers at random	46.4	44.3

Sources: Data on Connecticut and South Carolina drivers from H. R. DeSilva, "Results of Speed Studies in Connecticut and South Carolina," *Proceedings of the Highway Research Board,* 20, 705 (1940). Data on Ohio drivers from C. H. Lawshe, "Studies in Automobile Speed on the Highway," *J. Appl. Psychol.,* 24, 9 (1940).

TABLE 21

AVERAGE SPEEDS OF MEN AND WOMEN DRIVERS

(Connecticut and South Carolina)

Location of Observations	Speed	
	Men	Women
	M. p. h.	*M. p. h.*
Connecticut 1933–1934 (winter) [1]	43.0	41.9
Connecticut 1934 (summer) [1]	39.2	39.8
Connecticut 1939 (summer) [2]	44.1	43.1
South Carolina 1940 (winter) [2]	45.7	44.7

Source: 1 C. J. Tilden, D. L. Morris, T. M. C. Martin, and E. W. Russell, *Motor Vehicle Speeds on Connecticut Highways,* p. 28. Yale University, Committee on Transportation, 1936, New Haven, Conn.

2 H. R. DeSilva, "Results from Speed Studies in Connecticut and South Carolina," *Proceedings of the Highway Research Board,* 20, 703 (1940).

they are traveling. Perhaps it is chiefly the high-speed male drivers who are held back by female operators.

Average speeds are interesting in this connection, but equally important are figures showing the proportions of men and women who drive at excessively high speeds. In the 1939 Connecticut study only 2 of the drivers exceeding 60 miles per hour were women; 24 were men. In South Carolina only 5 of the drivers exceeding 60 miles an hour were females; 103 were males. In other words, many more men than women drive at dangerously high speeds.

Traffic Volume and Speed

In cities where traffic is heavy there seems to be a close relationship between traffic and speed. Automobile speeds are highest during the early hours of the morning when traffic is lightest, and lowest in the late afternoon when traffic is heaviest. [85, *113*]

Studies made by the U. S. Public Roads Administration indicate that on open rural highways the effect of traffic volume on speed is a gradual one. A driver's speed seems to be somewhat retarded as soon as one other car appears on the road. As the congestion becomes greater and greater, the speed of each vehicle is governed more and more by the speed of the preceding vehicles. This results in a marked decrease in the mean difference in speed between successive vehicles, although the decrease in average speed may be slight. [217, *227*] Fast drivers are slowed down relatively more than those motorists who travel at moderate and slow speeds. In congested traffic, fast drivers are unable to pass freely and are forced to adjust their speeds to that at which other cars are moving. There is no critical point in the increase in volume at which the speed drops markedly, until congestion becomes so great that the cars cannot pass one another. At this point the average speed of all cars is primarily determined by the speeds of the slowest ones.

Seasonal, Daily, and Hourly Variations in Speed

Tilden found the highest average driving speed to be in the fall and winter, followed by that in the spring, with the lowest average driving speed in the summer. [275, *17*] But he concludes that these seasonal differences are not primarily attributable to any direct effect of the weather, nor to any change in driver habits, but principally to the addition of a distinct class of slow pleasure drivers in the summer.

Tilden also found that Sunday speeds on main rural highways were low, partly on account of the larger volume of traffic, and partly, perhaps,

because of the more aimless attitude of the Sunday driver who, having no fixed destination, is less interested in going somewhere in a hurry.

Variations in average speed throughout the day are described by Tilden as follows:

> The most noticeable common property of all graphs [showing average speed at hourly intervals] is found in the nearly universal falling off in speed as the day progresses. In general, the highest average speed occurs shortly after daybreak, while the lowest average speed occurs soon after nightfall. The "spread" between the high and low average speeds is about 7 or 8 miles per hour. [275, *23*]

In studies made in Connecticut, Illinois, and Minnesota, the average speed of passenger cars at night was found to be around 4 miles per hour lower than during the daytime. [224, *36*] In the Connecticut study by Tilden the difference was greatest in winter (4.6 miles per hour) and least in spring (2.6 miles per hour). These data indicate that many drivers recognize the need for reduction of speeds at night. Unfortunately, however, a considerable number of drivers do not fully realize the hazards of night driving and continue to travel as fast at night as in the daytime.

Effect of Weather Conditions on Speed

Tilden pointed out in his study that on rural highways weather influences driving speeds in three ways: (1) through its psychological effect on the operator; (2) through reductions in visibility caused by snow, rain, or fog; and (3) through the bad surface conditions which snow, ice, or water on the road creates.

Although they discouraged driving at the highest speeds, light rains and slightly wet concrete pavements had little effect on the average speed of Connecticut drivers. A hard rain or light snow lowered the average speed by 5 to 10 miles an hour. Snow or ice on the road lowered the average speed by 10 to 15 miles an hour, the greatest decrease shown from normal average speeds, and had the general effect of equalizing the speed on all highways by causing a much greater drop in speed on high-speed highways than on other roads.

The study revealed that in general the practice of the motoring public on main rural highways is to adjust its speed to the relative danger of road hazards encountered.

Effect of Type of Road Surface on Speed

In a study made in Iowa it was found that the average speed on concrete roads was approximately 10 miles per hour faster than on gravel

roads. [224, *23*] If this finding is corroborated generally then it should follow that other things being equal the more concrete highway a state has the faster would be the average speed of travel in that state (see Table 47).

Effect of Pavement Width on Speed

Recent investigations show that the faster a vehicle travels the farther it tends to move over to the center of the road. [126, *43*] In a study of traffic on a 20-foot pavement the average edge clearance of vehicles moving without restriction from other vehicles at speeds of 30 to 39 miles per hour was 2.8 feet, whereas the average edge clearance of such vehicles traveling 40 to 49 miles per hour was 3.2 feet. [126, *44*] It follows that roads built for higher speeds should be wider than those built for lower speeds. In general, narrow roads discourage high speeds, especially when there is considerable traffic.

STATE SPEED LAWS

The fundamental speed law in almost every state is a statute embodying the common-law rule that no person shall drive a vehicle on a highway at a speed greater than is reasonable and prudent under the conditions then existing. [232, *86*]

In addition to this statute most states have prescribed maximum lawful speeds to apply in various areas. A few states have a fixed, maximum speed which it is unlawful to exceed anywhere in the state. A considerably larger group of states set *prima facie* maximum legal speed limits. This means that a motorist charged with exceeding the speed limit may show that, although he was exceeding the statutory speed limit, he was exercising reason and prudence in so doing. If he is able to convince the authorities of his discretion he may escape conviction. A few states have no maximum speed limit, relying solely on the basic rule of prudence to guide the motorist.

The trend in recent legislation has been to raise the prevailing speed limits. Some states, however, still have ridiculously low limits on their books, such as 30 miles per hour in Massachusetts, and 35 miles per hour in Idaho and Rhode Island. [203, *24*]

Lack of uniformity in maximum speed regulations is confusing to the motorist who travels from one state to another, since he cannot always be sure whether his driving speed is within the law. It may well be that the widely varying conditions in different sections of our country make it impossible and undesirable to try to establish uniform speed laws, but in any case, before we can hope to go farther in speed regulation we

TABLE 22

STATE SPEED LIMITS FOR PASSENGER VEHICLES

July, 1941

(Compiled from State Motor Vehicle Laws and Data Furnished by State Officials)

State	Equiv. of Basic Speed Rule	General State-Wide Speed Limits							Authority to Fix Other Limits			
		Values in m.p.h.					Types		Power of state to zone sections of state highways[1]		Municipalities' power to fix or alter limits[2]	
		Rural	Sub-urban	Res. dist.	Bus. dist.	Other	Prima facie	Abso-lute	Prima facie limits	Abso-lute limits	Prima facie limits	Abso-lute limits
Ala.	x	..		25	15–20	(a)	x		..	..	x(j)	..
Ariz.	x	..		25	20	(a)		x	..	x	..	x(j)
Ark.	x	60		25	20	(a)	x		x(h)		x	..
Cal. (c)	x	55		25	25	(a)	x		x(k)	..	x(k)	..
Colo.	x	60–20		30	25	(a)	x(g)		x(h,g)	..	x	..
Conn.	x	50–40(f)		..	..		x(d)		x	..	x	..
Del. (c)	x	50–55(s)		35	25			x	..	x	..	x
Fla. (c)	x	60–50(f)		25	25		x		x	..	..	..
Ga.	x	55		..	..			x	..	x		x
Idaho	x	35		20	15–20	(a)	x		..	..	x(j)	..
Ill.	x	..	35	25	20		x		x(o)	..	x	..
Ind.	x	..		30	20		x		..	x	x	..
Iowa	x	..	45	25	20			x	..	x(h)		x(j)
Kans.	x	..		30	20		x		x(h)	..	x	..
Ky.	x	45		25	20	(a)	x		..	..		..
La.	x	..		..	..	25(e)		x	..	..	x	..
Me.	x	45		25	25	(a)	x		x(h)		x(j)	..
Md.	x	50–55(s)		30–35s	25–30s			x	..	..	..	..
Mass.	x	30	30	20	20	(a)	x		..	..	x(k)	..

Mich.	x	..		25	25		x		x	x	x(j)	..
Minn.	x	60–50(f)	30q	30(q)	30(q)		x	x		x	..	x
Miss.	x	55		25	20	(a)	x		x(h)	..	x	..
Mo.	x	25		..	..		x			..	x	x
Mont.	x	55(f)		25(d)	25(d)	(a)	x		x	..	x	x
Nebr.	x	60–50(f)		25(r)	20(r)		x	x	x(h)		x	..
Nev.	x	..		..	..				..	..	x	x
N. H.	x	(d)	(y)	25	20	(a)	x		x	..	..	..
N. J.	x	40–45(v)		20	20–15	(a)	x		x(v)	..	x(m)	..
N. M.	x	..		25	20	(a)		x	..	x(h)	..	..
N. Y. (c)	x	40	40d	..	..		x		x	x(c)	x(k)	
N. C.	x	45–60w		25	20		x	x(w)	x(h)	..	x(j)	..
N. D.	x	50		25	25	(a)	x			..	x(j)	..
Ohio (c)	x	50	25b	25(b)	25	35(b)	x		x	..	x(j)	..
Okla.	x	..		..	..		..	..		..	x	x
Ore. (c)	x	55		25	20	(a)	x		x	..	x	..
Pa. (c)	x	50–70t		35–25	35–25	(a)		x	..	..	..	x(n)
R. I.	x	35		20	20		x		x		x	..
S. C.	x	55		35	25			x	..	x(h)	..	x(h)
S. D. (c)	x	60–50f		30(r)	20–15r	(a)	x	x		x	x(j)	..
Tenn.	x	..		30	30	(a)	x		x(h)	..	x(h)	..
Tex.(c)	x	60–55f	30	30	30			x	..	x(h)	..	x
Utah (c)	x	60–50f		25	25		x		x	..	x	
Vt.	x	50		..	..			x	..	..	..	x(k)
Va.	x	55	35z	25	15	(a)		x	..	x(h)	..	x
Wash.	x	50		25	20	(a)		x(u)		x(h)	..	x(k)
W. Va.	x	45	25	25	20	(a)		x	..	x(h)	..	x(j)
Wis. (c)	x	..	35	25	25	(a)		x	..	x(p,c)	..	x(j)
Wyo.	x	60	..	30	20	..	x		x(h)	..	x	..

Source: *Report of National Safety Council Committee on Speed Regulation, 1941.* National Safety Council, Chicago, Ill.

(a) Special limits for obstructed curves, intersections and/or at schools. (b) 35 m.p.h. on through highways. (c) New law in 1940 or 1941. (d) Department regulation. (e) Limit in unincorporated places. (f) Night limit. (g) Enforced as absolute limits. (h) Authority to decrease limits only. (j) Authority to increase limits only. (k) Authority to adjust within limits specified in state law. (m) May change speed on signalized streets. (n) May post 25 or 35 m.p.h.limits. (o) In municipalities only. (p) In certain counties only. (q) Absolute limits. (r) Prima facie limits. (s) On dual lane highways. (t) 70 on turnpike. (u) Also prima facie evidence of reckless driving. (v) 45 m.p.h. zones. (w) 60 m.p.h is absolute limit. (x) Yes. (y) 35 m.p.h. in rural residence districts. (z) Certain cities and streets.

1 Twenty states have special authority to set absolute limits at bridges.

2 Subject to state approval in many states.

need to determine reasonable top speeds under various road conditions. Even if we can never secure uniform state speed laws at least we should try to provide the most suitable speed limits for individual situations.

SOLUTION OF THE SPEED PROBLEM

Speed control comes nearer to offering a single solution of the accident problem than anything else that has been suggested. In nearly every city or state where a serious effort has been made to cut down the speed of drivers a marked reduction of accidents has followed. In the state of Pennsylvania a successful effort at limiting the top speed of drivers on the highways to 50 miles per hour was followed by an abatement of accidents in 1938. Probably the control and limitation of high-speed driving has a more marked effect on reducing the number of rural accidents than any other single measure.

This does not mean though that speed control is the only effective means of solving the accident problem. Nor will speed control, no matter how drastic, eliminate all accidents. There are a great many accidents which cannot be blamed on fast driving. Poor visibility, fatigue, drunkenness, inferior skill, faulty attitude, and a number of other factors also contribute heavily to accidents.

It is clear, however, that we must curb the tendency of a minority of motorists to drive at a speed higher than wise on our increasingly speed-inducing highways. For the control of these drivers who will not keep their speed within reasonable bounds, we must devise workable means of restraint.

The best summary of general suggestions for the control of speeds on rural highways is contained in a special report to the Highway Research Board by R. G. Paustian. [224] This study should be read by everyone who has charge of the regulation and control of driving speed. Another important reference is the latest annual report of the National Safety Council Committee on Speed Regulation. Some of the suggestions and recommendations offered in these reports have been incorporated in the discussion of speed control tactics which follows.

The first and most important thing to be done in attacking the speed evil is to make a thorough investigation into human ability to manage automobiles at different speeds. About this vital matter we know very little at present.

A second point, is to discover who are the speeders and to study them to find out why they speed. Average driving speeds along highways are usually reasonable, but some drivers drive much faster than the average. Do they do this because they started late and are in a hurry, because they

have come to a better road which invites them to go faster, because they are in a new car whose speed is deceptive, or because they are starting on a long trip and feel they must make time? If we knew more about why drivers speed, we should have valuable information to aid us in taking steps to check them.

In the third place we must establish some uniformity in speed laws to take into consideration the number and importance of the hazards encountered on different stretches of road. In order that reasonably long stretches of rural highway may be zoned for a uniform speed it is important for highway designers to try to equalize the hazards. Where the cost of eliminating a serious hazard in an otherwise hazard-free stretch of highway is prohibitive, effective signs must be employed to ensure that motorists slow down to a safe speed. It is perhaps desirable to set night speed limits lower than for day.

Fourth, we must see that speed regulations are strictly enforced. Sufficient traffic policemen must be provided, both in cities and on state highways to curb speeding. Ticket fixing must be eliminated and violations dealt with impartially and consistently by the police, courts, and motor vehicle departments.

A fifth step is to adjust the punishment to fit the crime. A cumulative system of fines increasing with each offense usually works better than fines of fixed amounts which disregard the number of offenses committed. Still more successful, because of the inconvenience it causes the erring motorist, is the suspension of his permit to drive or the confiscation of his license plates. If loss of driving privileges were used more often to punish motorists for repeated infractions of the speed laws, there would be fewer violations.

Another phase of speed control, much neglected to date, is that of reducing the number of "passing" accidents by encouraging motorists to travel within a certain speed range, especially in cities and on crowded two-lane highways. We need to hasten the slowpoke driver and to curb the high-speed operator. By setting minimum as well as maximum speed limits according to the conditions prevailing, and by enforcing these limits, accidents resulting from passings would be lowered.

In cities which have adopted a fixed maximum speed law, it has been found that with proper enforcement and education the great mass of drivers can be taught to travel within a fairly narrow range of speed. Thus, in the city of Providence, where the maximum speed limit is 25 miles per hour and the accident rate markedly low, Ralph Eaton, the city's traffic engineer, has found that 85 per cent of all drivers travel between 20 and 30 miles an hour, whereas less than 1 per cent drive faster than 30 miles per hour, and only 14 per cent slower than 20 miles per hour.

Unquestionably, hazards are reduced when the control of traffic within certain fairly narrow limits makes fewer passings necessary. Stricter control of the speed range of vehicles in and around large cities is particularly needed.

Speeding by itself is not necessarily a cause of accidents, but few persons have the skill or the training requisite to driving fast safely. If a driver traveling at 20 miles an hour is careless he can usually act in time to avoid a possible accident, and if it occurs, the consequences are not often serious. At 60 miles an hour, a driver making the same mistake cannot possibly act quickly enough to avoid an accident, and when it occurs, loss of life usually results.

Fortunately the majority of motorists travel most of the time at reasonable speeds. Trouble arises primarily from a small group of chronic speeders, from the owners of new cars, and drivers on long trips. Appropriate measures must be taken to control these drivers. We must also limit the maximum speed on our improved rural highways since widening and improving the surface of our main highways normally leads to more accidents unless speed is controlled.

Speeding is a subject which to date has not been sufficiently investigated. Further studies on its various aspects are much to be desired (see Chapter XVI for suggestions for further research).

CHAPTER IV

SKILL

Driving skill is the third factor influencing a driver's susceptibility to accidents. It has been generally ignored, for Americans have taken the right to drive a car so much for granted that they have given little thought to the skills which a driver should possess.

GENERAL DIFFERENCES NOTED IN DRIVING ABILITY

Although we are comparatively ignorant of just what human abilities are required to handle a car under present-day driving conditions, and just what deficiencies in skill cause or contribute to accidents, certain general differences in driving ability have been observed.

Influence of Age in Learning to Drive

Driving instructors report that persons differ considerably in the ease with which they learn to drive. Some individuals, who seem to take naturally to driving a car, require a minimum of instruction. Other persons take five to ten times as long to learn.

One of the most important factors affecting learning is *age*. Rejections for failure to drive satisfactorily in the license examination road test increase with the age of the applicants (see Figure 12).

Driving instructors state that young persons learn to drive more quickly than their elders. Young people pass better driving tests and most of them handle their cars more easily and confidently than older drivers. According to driving teachers after the age of 25, proficiency in driving skill becomes more difficult to acquire than at earlier age levels, and drivers over the age of 55 show a marked inferiority in the proficiency achieved.

Influence of Sex in Learning to Drive

As for sex differences, investigations indicate that young women learn to drive almost as quickly as young men, [176] but that with advancing age women require more and more instruction than men, elderly women

having considerably more difficulty in learning to drive than men of corresponding ages.

Influence of Professional Interest on Driving Skill

Bus and truck operators and chauffeurs are usually superior in skill to the private driver. Since the livelihood of those hired as drivers depends on handling their vehicles properly, they naturally have a strong

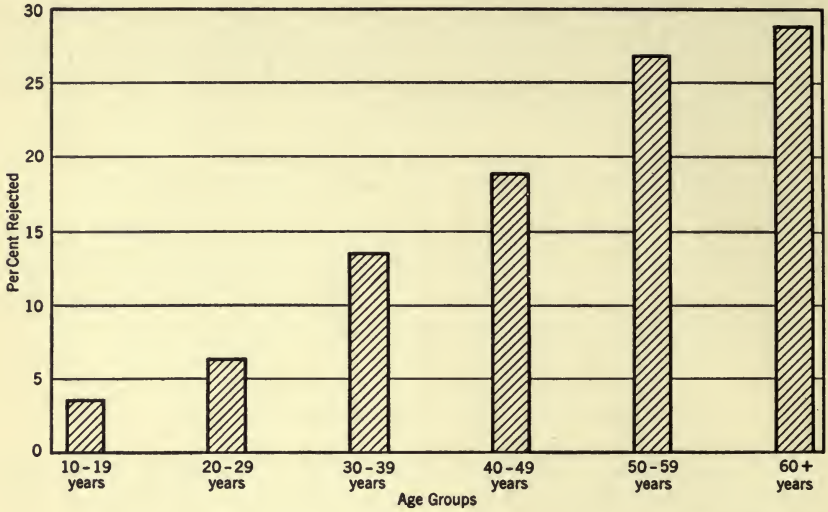


Fig. 12. Percentage of applicants of different ages rejected on road driving test (Connecticut, 1932).

Source: Hilda M. Keller, "Study of Persons Examined for Driver's Licenses," (unpublished report). Connecticut Department of Motor Vehicles, 1932.

incentive to keep their driving up to par. It is not surprising, therefore, to find that although the fatal accident rate for passenger cars has been increasing over a period of years, that of buses and trucks has been declining. [201, *48*]

Professional drivers, who must drive regularly throughout all seasons of the year and under all conditions of traffic, have thrust upon them the opportunity to develop driving skill. They not only learn through experience how to avoid dangers by anticipating them, but also acquire all the tricks of extricating themselves when they are unfortunate enough to become involved in hazardous situations. They know how to use their brakes effectively; how to get out of skids; how to steer between two obstacles when there are only inches to spare; and how, in case of necessity, to pick out the least destructive form of collision.

Particularly expert are the test drivers who work for automobile and tire manufacturers. Their day-in and day-out experiences in handling cars at high speeds and in stopping them quickly has taught them how to carry out in safety what for the ordinary driver would be foolhardy maneuvers. Professional daredevil or "stunt" drivers who go about the country giving exhibitions at fairs and places of amusement represent the peak of driving skill.

Both these two latter groups depend for their safety on preparedness and practice. They see to it that their cars are in top-notch condition and before trying out new stunts, familiarize themselves with every foot of the road to be covered and plan every action. Their most risky performances are carried out only after they have acquired the necessary skill through a great deal of practice at slower speeds and under less perilous conditions.

The average driver must not think he can emulate the dangerous performances of these "super-drivers" without similar painstaking preparations and practice. As such drivers themselves are emphatic in stating, the place for fancy driving is on the special driving tracks, not on the public highway.

TESTS OF DRIVING SKILL

Numerous attempts have been made to devise and apply tests to measure certain general differences, touched on above, which are found in the ease with which individuals learn to drive; also to measure differences in native ability, or natural aptitude for driving. [4, 32, 41, 42, 89, 149, 180, 181, 182, 187, 188, 262, 284, 288]

Tests of driving skill fall into two general classes, namely, those depending on rating by human beings which are given at the wheel of a car, and those depending on apparatus which are given under controlled laboratory conditions.

Road Tests

A road test as it is administered by state motor vehicle departments is primarily a qualifying examination to determine how well the applicant has mastered the most common manipulations necessary in handling a car. The examiner pays little attention to the question of whether the applicant has other qualifications which will make him a good driver under other situations. Instead he is concerned with determining whether the applicant at that moment and in those particular circumstances can handle a car properly.

The easiest and most reliable test of the manifest extent of ability to handle a car is an examination of complex behavioral units such as gear

shifting, or stopping on a hill, which the average person cannot carry out properly without adequate preliminary practice. The road test, therefore, emphasizes experience in contradistinction to overall potential ability. It is primarily an indicator of extent of experience, not of native ability or of accident-proneness.*

In recognition of the inadequacy and the lack of uniformity of state systems of examining drivers, the American Association of Motor Vehicle Administrators requested the Yale Driver Research Center to develop a set of uniform driver examination standards. Such standards, as well as the procedure for administering the examination, have been approved by the Association and recommended to all states for adoption. [6, 9, 11]

The road examination as adopted by the Association includes the following items:

1. Starting.
2. Stopping, both ordinary stop and emergency quick stop.
3. Turning, at least three right and three left turns.
4. Backing.
5. Parking. Applicant must park his car parallel to the curb between two other cars or stanchions.
6. Turning in opposite direction.
7. Intersections and signs. Applicant must demonstrate his ability to handle the car safely at eight intersections and under different traffic conditions.
8. Passing and being passed.
9. Starting and stopping on hills. Applicant should be made to simulate starting and stopping on an upgrade if no adequate incline is available.
10. Controlling speed according to conditions.
11. Driving smoothly.
12. Being attentive.
13. Observing correct attitude toward other drivers and toward pedestrians.

Detailed specifications as to what constitutes satisfactory and unsatisfactory performance on the various test items are available in the Association's *Procedure* for the examination, from which the examples below are taken:

Stopping

Satisfactory: Applicant anticipates stops well in advance, signals properly, and comes to a gradual halt. Applicant makes good emergency stop.

* A road test might, of course, be devised primarily to ignore the manifestations of training and concentrate on general overall differences in ability, but since most of the manipulations necessary to drive a car require training it would not be feasible to give a road test to untrained drivers. However, by a careful selection of items, and proper training of examiners it might be possible to use the road test on experienced drivers to try to distinguish between their potential ability as contrasted with the ability they have acquired through practice.

Unsatisfactory: Failure to signal a stop when other cars are following. An abrupt stop, slow reaction in emergency, or not anticipating hazards. Applicant makes poor emergency stop because of slow reaction, lack of strength, or poor brakes.

Turning

Satisfactory: Applicant looks in mirror for following cars. Signals with hand, gets into proper lane well in advance of the turn, and turns properly. His right turns should not be too wide, nor his left turns too close. He must "position" his car promptly and correctly.

Unsatisfactory: Failure to look in mirror, signal, get into proper lane. Swings too wide or too short on turn.

It is also recommended that each examiner be furnished with either a rating sheet or a score sheet. The recommended rating sheet includes the items listed on the previous page with places to check whether they were satisfactory or unsatisfactory. See Figure 13 for a suggested scoring sheet. States are advised to adopt the scoring system best suited to their needs.

Suggestions are also offered by the Association for laying out a standard road test course, a sample map of which is reproduced (see Figure 14).

It is advised that not only should all new examiners be given a thorough training, but also that experienced examiners should be called together at least once a year for a refresher course to bring them up to date on any changes in methods and legislation. These practices are recommended to promote closer uniformity in administering the examination by different men in different parts of the state. Methods of keeping check on the examiners to be sure that they give the standard examination in the prescribed way are also described.

Apparatus Tests

Besides the drawback that it is primarily a test of experience rather than of potential ability, the road test has other shortcomings. One is that it depends on human judgment, which, no matter how well trained the observer, is notoriously subject to bias and error. Another is that it is seldom possible or feasible in such a test to subject the operator to complex traffic conditions or dangerous road situations. At the best, road tests are only crude indicators of ability. Scientific apparatus for measuring human behavioral responses, on the other hand, makes for better-standardized, faster, and more comprehensive driver observation.

Apparatus Makes for More Standardized, Faster, and More Comprehensive Observation. Road test examiners who are subject to personal likes and dislikes and have limited powers of observation, make

ROAD TEST SCORE SHEET

NAME OF APPLICANT.....DATE OF EXAMINATION.....
ADDRESS OF APPLICANT.....LEARNER'S PERMIT NO.....

GROUNDS FOR IMMEDIATE FAILURE None.....
1. Accident.....
2. Dangerous Action.....
3. Violation
Type.....
4. Lack of Cooperation.....
5. Dangerously Inexperienced....
6. Unable to Start Car.....
7. Frequent Stalling.....
8. Poor Brakes.....

I. STARTING Satisfactory.....
1. Fails to look around before starting.. 5-10.....
2. Noisy and uncertain gear shifting..... 2- 5.....
3. Stays too long in low or second gear.. 1- 7.....
4. Unnecessary fast getaway..... 2-10.....

II. STOPPING AND EMERGENCY STOP Satisfactory.....
1. Fails to signal..... 5-13.....
2. Slows down too suddenly..... 2-15.....
3. Fails to anticipate stops in advance.. 5-15.....
4. Reacts slowly in emergency stop..... 5-20.....
5. Insufficient strength to stop car quickly.....10-30.....

III. TURNING Satisfactory.....
1. Fails to get into proper lane in time. 5-20.....
2. Fails to signal..... 5-20.....
3. Fails to look in mirror or out of window.....10-20.....
4. Swings wide to the right or cuts corners to the left..... 5-20.....

IV. BACKING Satisfactory.....
1. Fails to look behind before and while backing.....15-30.....
2. Uncertain steering when backing..... 5-15.....

V. PARKING Satisfactory.....
1. Hits other cars with a jolt when parking..... 5-15.....
2. Climbs curb in parking..... 5-15.....
3. Parks too far from curb..... 2-10.....
4. Forgets to set emergency brake..... 2-10.....
5. Failure to park satisfactorily after two attempts..... 5-10.....

VI. TURN-ABOUT Satisfactory.....
1. Fails to look in all directions..... 5-10.....
2. Generally unsatisfactory operation... 5-10.....

VII. INTERSECTIONS AND SIGNS Satisfactory.....
1. Does not come to full stop at stop sign or red light..... 5-10.....
2. Starts too quickly for green..... 5-15.....
3. Does not start promptly on green..... 2- 8.....
4. Does not notice caution or warning signs..... 5-10.....
5. Fails to observe direction signs..... 5-20.....
6. Stalls at intersections..... 5-25.....
7. Takes right of way at intersections when not entitled..... 5-25.....
8. Fails to signal properly..... 5-10.....

VIII. PASSING AND BEING PASSED Satisfactory.....
1. Does not await clear distance ahead.....10-30.....
2. Uncertain-Starts and changes mind 5-15.....
3. Passes car in intersection when unlawful or dangerous to do so..... 5-30.....
4. Passes vehicle on right where unlawful.....10-30.....
5. Fails to use horn as required by law..... 2- 5.....
6. Too little speed in overtaking... 3-10.....
7. Cuts in too quickly ahead.....10-30.....
8. Speeds up when being overtaken...10-30.....
9. Passes standing street car when unlawful..... 5-25.....

IX. STARTING AND STOPPING ON HILLS Satisfactory....
1. Cannot shift gears on an upgrade. 5-20.....
2. Cannot stop and start on hill without rolling backward. 5-25.....
3. Descends in neutral--cannot shift going down..... 5-25.....

X. SPEED CONTROL Satisfactory.....
1. Speeds greater than ability warrants..... 5-20.....
2. Too fast over rough roads, around corners, through blind intersections and in business districts..... 5-20.....
3. Slows down while passing through an intersection or around a curve, rather than before reaching it.....10-20.....
4. Hinders traffic by driving slowly in center of street... 5-20.....

XI. SMOOTH DRIVING Satisfactory.....
1. Wanders on roadway and fails to keep in correct lane..... 5-15.....
2. Accelerates and applies brakes too suddenly so as to give a jerky ride..... 5-10.....
3. Follows too closely..... 2-10.....
4. Uses horn too much..... 5-10.....

XII. ATTENTION Satisfactory.....
1. Looks down when shifting gears... 5-15.....
2. Turns head when talking..... 5-20.....
3. Fails to notice pedestrians and other dangerous spots.... 5-20.....
4. Does not give complete attention to all traffic intersections..... 5-20.....

XIII. ATTITUDE TOWARD OTHERS Satisfactory.....
1. Depends on others for safety..... 5-25.....
2. Does not take right of way when given it..... 2-10.....
3. Inconsiderate of pedestrians..... 5-20.....
4. Fails to anticipate what other may do..... 5-20.....

Total Deductions..... .....

REMARKS:.....
.....
.....

Original..... Score.....
Retest..... ..... Passed.....
EXAMINER Failed.....

....
APPLICANT'S SIGNATURE PLACE OF EXAMINATION

FIG. 13.

Source: *Driver License Examination Procedure*, p. 37. American Association of Motor Vehicle Administrators, 1940, Washington, D. C.

their judgments not on the basis of measurement, but of opinion. In contrast, apparatus is objective. It is consistent and treats everyone the same. Not requiring the unwelcome presence of an eagle-eyed examiner

Fig. 14.

Source: *Driver License Examination Procedure,* p. 55. American Association of Motor Vehicle Administrators, 1940, Washington, D. C.

it is impersonal and therefore elicits more uniform attitudes and more uniform responses on the part of the subjects.

In driving, human reaction times such as those required to apply the brake after seeing a hazard ahead, are so short that we cannot evaluate them with our own eyes. For the measurement of such rapid responses

we need scientific apparatus constructed to measure in hundredths of a second.

Automobile driving continually calls for the ability to do several things at once, or in quick succession. Comprehensive observation of such a series of quick responses is possible only with the aid of scientific apparatus. Without the assistance of apparatus, no person, regardless of how experienced and expert in driving he might be, could possibly observe and

Fig. 15. Motion picture driving test.
Source: Courtesy G. B. Finnegan and H. N. Durham.

estimate accurately and uniformly differences in the ability of drivers to carry out several activities at once, such as are frequently required in traffic.

Apparatus Offers the Possibility of Measuring Responses to Complex or Dangerous Situations. It is seldom feasible to introduce an emergency situation into a road test on account of the possibility of physical injury. In the controlled laboratory situation, on the other hand, a driver may be subjected to stress without danger of a collision.

The most practicable laboratory method of testing a driver's behavior under stress is by means of moving pictures. The device illustrated above has been developed to present to the subject a series of unexpected road situations and to measure his reactions to them. Since, however, this apparatus has not yet been tried out under controlled conditions, much work

remains to standardize it and to validate it as an indicator of safe driving ability.

Testing Reaction Time, Coordination, and Ability to Do Several Things at Once. Several pieces of apparatus have been used to measure

FIG. 16. Moving-road-scene driver-testing apparatus.

a driver's general motor aptitude, particularly his coordination, speed of reaction, and ability to carry out several activities at once. [28, 48, 51, 74, 109, 114, 146, 151, 152, 185, 186, 245] More research is needed on apparatus for this purpose, however, in order to standardize it and to establish its value.

One of the devices which has been developed to measure a person's ability to manipulate the controls of an automobile in a laboratory is illustrated above. This apparatus tests: (1) a person's eye-hand coordi-

nation while using a steering wheel, (2) his braking-reaction time, and (3) his ability to do several things at once or in quick succession.* [74]

During the first test, the miniature road scene moves back and forth slowly and irregularly for a period of one minute and twenty seconds, during which time the subject is instructed to keep the miniature hood of his car in its proper position on the right side of the road. Whenever he steers too far to the right of the correct path, a signal light to the right shines; when he gets off to the left, a signal to the left lights. No score is taken during the first twenty seconds, this time interval being used as a practice period to acquaint the subject with the operation of the test. At the end of the practice period a score clock on the left starts to record the subject's performance, and when the minute of the test is over, it shows his rating by indicating the amount of time that the car was kept in the proper lane.

The subject starts the second test by pressing his right foot on the accelerator pedal, thus turning on a green traffic light. After an irregular interval, a red light goes on, at whose appearance the subject must apply his brake as quickly as possible. If he lifts his foot from the accelerator before the red light appears, the test will not operate. In this test one score clock indicates the time that elapsed between the appearance of the red light and the removal of the right foot from the accelerator. A second score clock indicates the time that passed between the appearance of the red light and the application of the brake. The reaction time measured by the first clock is known as the mental-reaction time, and that measured by the second clock, as the braking-reaction time.

In the third test the subject is instructed to steer his car as in the first test, at the same time responding quickly to different types of signals such as a red traffic light, or a suddenly appearing vehicle, either by applying the brake or by pressing a light-dimmer switch. Here one clock measures the score on the steering test, and the second clock the reaction times.

Significance of Reaction Time in Driving. As was pointed out in Chapter III, a quick reaction time is desirable in a driver to enable him to stop a car at high speed as quickly as possible. Fortunately there is a general tendency for persons with slow reaction times to make up for this handicap by driving more slowly. Thus the writer discovered a few years ago that persons who reported open-road driving speeds of 60 miles per hour or over had on the average quicker reaction times than persons who reported open-road driving speeds of 40 miles per hour or less. But although most persons with slow reactions were found to travel at slow speeds there were exceptional cases of persons with reaction times

* A gear-shift lever is also available to check the driver's ability to shift gears.

suitable to 40-mile-per-hour speeds who reported driving at 60-mile-per-hour speeds.

From an educational point of view it is desirable that drivers be shown how they rate in braking reaction time and that they be taught the significance of reaction times in stopping a car. Few persons realize the long distance a car travels in the interval before the brakes are applied. It is especially important that an individual with a long reaction time be encouraged to compensate for this handicap by driving more slowly, by allowing more space between his own car and the car in front, and by being eternally on the alert.

A number of factors influence reaction time. Thus under the influence of fatigue, reactions may slow down considerably, and reaction time to a sound signal is generally quicker than to a light signal. [91] This means that the brake is applied a little more quickly in response to the sound of an automobile horn than to the sight of a flashing light. Distraction, in particular, lengthens braking reaction time. [114]

Significance of Coordination in Driving. In operating an automobile eye-hand coordination, that is, the ability of the eye to perceive everything on the road ahead and the ability of the hand to guide the car where the eye dictates, is basic. Normal eye-hand coordination facilitates steering automobiles around corners, and around curves at high speeds. It helps in avoiding skids, or if a skid has begun, in extricating oneself safely. It aids in averting collisions when the clearance on each side of the car is small, as in parking or in heavy traffic.

There are differences in native eye-hand coordination, but since it has been shown that nearly everyone tends to improve a particular type of activity by practice, it is desirable after showing drivers how they rate on steering ability to encourage those who rate poorly to strive to improve.

Significance of the Ability to Do Several Things at Once. Skill in any sport normally involves learning to carry out several actions at once, or several actions in succession. The extent of practice necessary in learning an activity requiring a complex series of movements seems to depend on the number of such movements involved and the speed with which they must be executed.

A driver ordinarily must develop a series of automatic habit patterns to deal with the variety of situations he encounters upon the road. Thus he must learn to shift gears, to use his clutch, to steer, to apply his brake, and to keep his mind on the road ahead, all at the same time. The degree of complexity of the activities which he is called upon to perform determines somewhat how successful a driver he becomes.

Thus the person who drives mostly on rural roads where there is little traffic will seldom encounter complex traffic conditions requiring unusual

ability. But the person who lives in a large city and operates his car on heavily traveled city streets or main rural highways will be subject to a series of complex situations which demand considerable skill to negotiate successfully. It is especially necessary that city drivers be able to respond skillfully and rapidly to complicated situations if they are to keep out of accidents.

Inferior natural ability to master a complex series of activities, however, naturally renders any driver's task of learning to drive more difficult, as well as limits the maximum degree of skill attainable.

The Relation of These Tests to Accident Susceptibility. The California Motor Vehicle Department recently tested the braking reaction time, coordination, and ability to react and steer at the same time, of two groups of drivers, "good" and "bad." [105] The good-driver group consisted of California highway patrolmen attending the annual patrolmen's school, and a number of commercial truck drivers—in all, 200 drivers who had motor vehicle records showing them to be safe and efficient operators. The poor-driver group consisted of 321 drivers whose records showed that each had been involved in either a fatal accident or in three or more injury accidents.

The results as indicated by the average scores of the good and poor drivers on apparatus like that described in Figure 16 are shown in the accompanying table. In simple braking reaction time, in simple steer-

TABLE 23

DIFFERENCES IN AVERAGE SCORES ON SIMPLE AND COMPLEX REACTION AND COORDINATION TESTS OF TWO GROUPS OF "GOOD" AND "POOR" DRIVERS (California, 1936)

	Braking		Steering	
	Simple	Complex	Simple	Complex
	Second	*Second*	*Based on 100*	*Based on 100*
Good drivers	0.377	0.472	84.4	76.4
Poor drivers	0.393	0.534	77.9	71.4
Critical ratio	4.2	9.0	7.8	4.6

Source: Edwin D. Fletcher, *Preliminary Report on Special Tests,* Part I, pp. 2, 4 (mimeo). Department of Motor Vehicles, Sacramento, Calif.

ing, and in both complex braking and steering tests the good-driver group rated better than the poor-driver group. (The lower the score in braking

the better the reaction, and the higher the score in steering the better the coordination.) In all four tests the differences in the average scores of the two groups of drivers are seen to be statistically significant.

The Relation of These Tests to Age. With advancing age reaction time, coordination, and the ability to carry out complex motor activities all decline. [73, *7;* 80, *51*] For this reason it is highly desirable from an educational standpoint that middle-aged motorists be taught the need to drive more slowly and cautiously to compensate for their failing skill.

The Relation of These Tests to Sex. Women rate lower on the average in reaction time, coordination, and complex activity tests than men. [80, *52;* 15] This characteristic is reflected in their actions on the road, where although women incur fewer accidents than men, they do not drive so skillfully. This inferiority in skill may be attributed to a variety of reasons: (1) women do not drive so much as men, and consequently do not have the same opportunity to develop skill under a variety of conditions; (2) they do not understand so well the operating characteristics of the car, and thus do not know so well how to adjust their actions to its mechanical requirements; or (3) women do not partake so much in out-of-door games and sports involving the development of eye-hand coordination, timing, and speed and distance judgment, which all are necessary in driving a car. Driving instructors agree that women, in general, do not handle cars so smoothly as men.

Vision Tests. Although railroad engineers and airplane pilots are required to have periodic examinations made of their eyes, since it is taken for granted that good vision is necessary in their work, many automobile operators, who drive vehicles capable of speeds up to 80 and 90 miles per hour, have never been required to have their eyes examined; they themselves do not realize the need for good vision in driving their cars.

Yet normal sight is vitally important in the safe operation of an automobile. The timely reaction to curves, intersections, pedestrians, other automobiles, and warning and directional signals, all depend on the ability to see at a reasonable distance what is ahead.

Visual Acuity. The most widely used test of visual acuity, or keenness of vision, is the Snellen chart. This chart consists of rows of letters of different sizes as shown in the illustration. Along the side of each row is a number which represents the distance at which a person with normal vision should read that particular line. In taking the test, the subject usually stands 20 feet from the chart. At that distance, if the smallest letters that can be read correctly are in the line marked "20," then the visual acuity rating is given as 20/20; the first 20 represents the distance

in feet from the chart, and the second number, the distance in feet at which the person with normal acuity can read the line of letters.

This rating is designated as standard or normal. If an individual at 20 feet can read the letters in the line marked "40" feet, but no smaller letters, then his visual acuity rating is given as 20/40. This means that whereas a person with normal visual acuity can read this line of letters

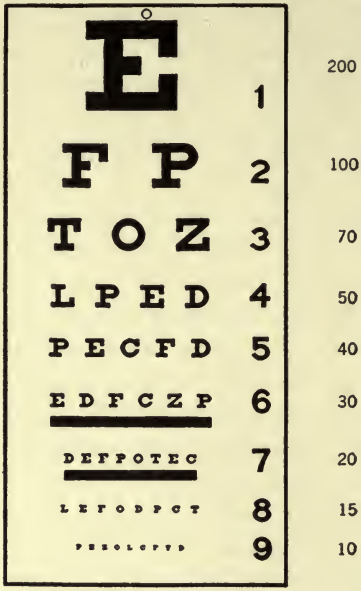


Fig. 17. Snellen chart for testing visual acuity (reduced in size). Source: Courtesy of the American Optical Company, Southbridge, Mass.

at 40 feet, the person with 20/40 acuity must be 20 feet from the chart to read them.

Let us suppose that a driver with 20/20 vision when using both eyes is just able to see a particular warning sign on the road at a distance of 150 feet. Another driver with only 20/40 acuity will not be able to read the same sign until he is within 75 feet of it, and a driver with 20/60 acuity will have to come to within 50 feet to read it.

The extent to which states have set up visual acuity requirements for new drivers can be seen from Figure 18.

Although it is universally accepted that vision is a most important factor in safe driving, there is a lack of agreement among psychologists and medical men as to what should constitute the minimum visual requirement for driving. [37, 53, 62, 65, 227, 289]

There being little evidence and no agreement on the minimum visual acuity necessary for safe driving, among those states which have set definite acuity requirements there is great variation in the standard chosen. It will be noted that the state minimum acuity requirements range all the way from 20/30 to 20/70 Snellen (see Table 24).

In an attempt to improve this situation the American Association of Motor Vehicle Administrators has recently suggested that the minimum

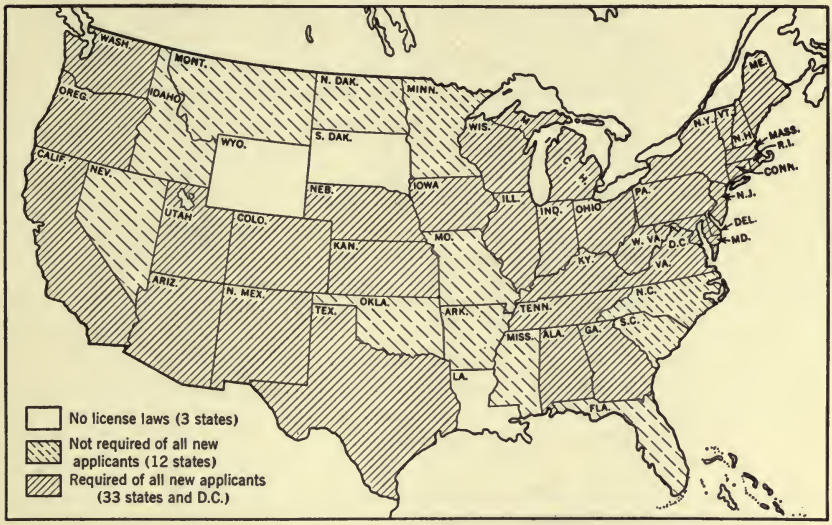


Fig. 18. States requiring vision test of all new applicants for a driver's license. Source: *Minimum Driver License Examination Standards*, p. 14. American Association of Motor Vehicle Administrators, 1939, Washington, D. C.

visual acuity requirement for a driver's license be set at at least 20/60 Snellen (using both eyes), and that any weakness in the eyes be required to be corrected by glasses which bring the vision up to this standard. [9] This is a very lenient rating and is not intended to represent the ideal norm.

Although the important role of visual acuity in safe driving has frequently been emphasized [162], the testing of the visual acuity of motorists is still anything but satisfactory in many states. In some states the administration of the visual examination as a license requirement is optional at the discretion of the examiner. In other states the examiners test only those applicants suspected of having visual defects. Examiners usually have had no special training and frequently conduct the examination under conditions that are far from ideal. It is not unusual, for

TABLE 24

STATE MINIMUM VISUAL ACUITY REQUIREMENTS FOR THE DRIVER'S LICENSE [1]

State	Rating
Arizona	20/40
Arkansas	20/30
California	20/50
Colorado	20/40
Connecticut	20/40
Delaware	20/30
Georgia	20/40
Illinois	20/40
Indiana	20/30
Iowa	20/40
Kansas	20/40
Kentucky	20/30
Maine	20/30
Maryland	20/70
Massachusetts	20/70
Michigan	20/40
Nebraska	20/40
New Jersey	20/50
New Mexico	20/40
New York	20/40
Oklahoma	20/30
Oregon	20/40
Pennsylvania	20/70
Rhode Island	20/65
South Carolina	20/30
Tennessee	20/30
Vermont	20/50
Virginia	20/70
Washington	20/50
West Virginia	20/40
Wisconsin	20/40
District of Columbia	20/40

1 States differ in specifying whether these requirements are for eyes used separately or together.

Source: Based on replies to questionnaires sent to the state departments in charge of licensing, 1939.

example, to find examiners in some states giving the eye test out-of-doors, where variable light conditions seriously affect the results obtained.

In recognition of such inefficient and divergent practices the American Association of Motor Vehicle Administrators has approved a uniform procedure and set of standards prepared by the Yale Driver Research Center for administering the visual acuity examination. [6] This procedure covers such items as:

1. The selection of a test chart.
2. The maintenance of the chart.
3. The location of the chart.
4. Control of illumination.
5. Control of the applicant.
6. Rules for passing or failing the applicant.

If state departments would adopt this recommended standard examination and give their examiners careful training in its administration, the result would be an accurate and fair determination of visual fitness for driving which would have in addition educational advantages. For some individuals, the eye test given during the license examination is the first check made of their eyes after leaving school; and for a large number, the first one they have ever had. It is important that motor vehicle departments avail themselves of this opportunity to inform applicants of their visual efficiency.

The Relation of Visual Acuity to Accident Susceptibility. In the California Motor Vehicle Department study mentioned above the percentage of operators with defective visual acuity of the right eye, the left eye, or both eyes, was found to be much higher in the poor-driver group than in the good-driver group. Similar results were obtained in another study. [80, *16*]

TABLE 25

DIFFERENCES IN THE PERCENTAGES OF FAILURES OF GOOD AND POOR GROUPS OF DRIVERS ON VISUAL ACUITY TESTS IN CALIFORNIA (1936)

	Acuity Left Eye	Acuity Right Eye	Acuity Both Eyes
Good drivers	7.0	7.5	1.0
Poor drivers	21.8	15.3	5.0
Critical ratio	5.0	2.8	2.8

Source: Edwin D. Fletcher, *Preliminary Report on Special Tests,* Part I, pp. 5, 7 (mimeo). Department of Motor Vehicles, Sacramento, Calif.

It is true that persons with less than normal vision can, if they are aware of their defects, drive more alertly and slowly, thus after a fashion offsetting their defective vision. People who are blind in one eye, for example, usually know of their handicap and compensate properly for it. [81] But clinical work in examining the eyes of automobile drivers has indicated that many persons with defective visual acuity make little effort to drive more carefully. A study was made of the drivers involved in fatal accidents in San Francisco during the first six months of 1936. [170] Drivers who had vision below normal in one of their eyes were

found to have had their fatal accidents on the side of their weak eye. Yet not one of these drivers was aware of his eye condition.

Another investigation of fatal accidents occurring at intersections revealed that the majority of such accidents were caused by drivers who

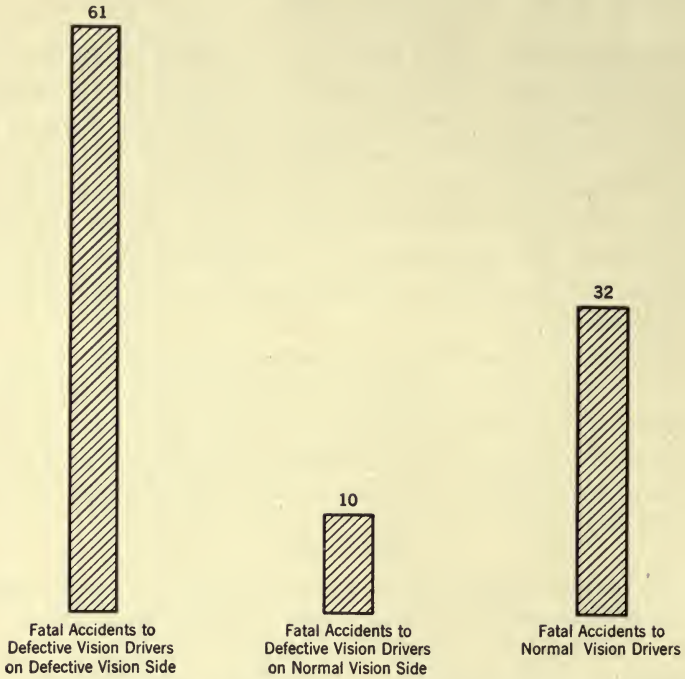


FIG. 19. Relation between defective vision and intersectional-type fatal accidents (California, 1938).

Source: E. D. Fletcher, *Preliminary Report on Special Tests,* Part I, p. 8 (mimeo). Department of Motor Vehicles, Sacramento, Calif.

had defective or restricted vision on the same side on which the accident occurred.

When 70 drivers who were arrested for "cutting in" on California highways were given vision tests it was found that more than half of them had one eye with subnormal acuity. [23] The poor eye was usually the right eye, which might explain why these drivers were cutting in, since the right eye is the one mainly used while passing other cars. There is also some evidence that lack of marked ocular dominance predisposes a driver to accidents. [241]

In the light of these studies it may be said that in general defective vision increases the likelihood of an accident.

Visual Estimation of Distances and Speeds. In driving an automobile our eyes must tell us not only *what* hazards are in front of us, but also *where* they are, and, frequently, *how fast* they are moving. A great deal is known about visual acuity, or the ability of the eyes to perceive small or distant objects accurately. Much less information is available about the ability of the eyes to perceive *where* and *how fast* things are moving. This estimation of distances, or "depth perception," and of speeds depends upon the coordination of the eyes and is impaired by any disturbance of that coordination.

Promising contributions to our knowledge of how the eyes work together, and of how to measure and correct imperfect depth perception are coming from the Eye Clinic at Dartmouth College. [293] The Dartmouth investigators have shown that in order to judge distances correctly not only must the eyes point accurately in the same direction and move in unison, but also the images from the two eyes must be exactly the same in size and shape. The defect which exists when the images differ is called aniseikonia (unequal images).

The ability to pass other cars safely on a two-lane road in the face of oncoming traffic depends on adequate depth perception. Undoubtedly many of the narrow escapes as well as the accidents resulting from such driving errors as "cutting in too sharply," "passing with insufficient distance ahead," and "following too closely" can be attributed to faulty judgment of distances and speeds on the part of the drivers concerned. [30] That the average driver is none too good a judge of the right moment to pass is indicated by studies made by the U. S. Public Roads Administration in which it was noted that a surprisingly large number of drivers did not attempt to pass the car ahead when the sight distance was longest, but waited until their view ahead was reduced and it was less safe to pass. [218] It would be valuable to measure the depth perception and speed estimation of a group of drivers who have been found to show poor judgment in passing maneuvers on the road.

It should be mentioned that in addition to faulty vision, lack of training in driving and poor physical condition may play a part in interfering with normal judgments of distances. Driving instructors report that the behavior of beginners in passing other cars is usually unskillful at first but improves with practice. Similarly, persons who have not driven for long periods of time report that their estimations of distances and speeds are not so reliable as formerly. Fatigue and haste may also reduce the accuracy of a driver's judgment of distance and timing.

Although normal estimation of distances (depth perception) and estimation of relative speeds are undoubtedly of considerable importance

in driving, so far no satisfactory devices have yet been devised to measure them. Further experimentation is needed to perfect such tests. [86, 127]

Night and Glare Blindness. At night some persons cannot see nearly so far down the road nor distinguish dim objects on the highway nearly so well as persons with normal night vision. This night blindness, or inability to see well at night, may not necessarily affect vision during the daytime, although in some cases it is accompanied by light sensitiveness (photophobia) in bright sunlight.

Another handicap which may affect night driving is glare blindness. A person who is glare blind is particularly sensitive to glaring headlights. Not only are glare blind persons more confused by the headlights of an oncoming car, but also, after the car has passed, they require a much longer period of time to recover from the glare and to see the road again than do individuals with normal glare vision. During the period of blindness caused by dazzling headlights the automobile may travel hundreds of feet while the operator is unable to see hazardous turns in the road or pedestrians walking along the highway.

Since our eyes adapt themselves to the dark by increasing their sensitivity, night blindness is measured by placing a person in a dark room and determining how his vision improves with the passage of time. The Hecht adaptometer is the most widely used device for measuring the ability to see in the dark. [121] It is, in simple terms, a light source whose intensity can be finely controlled and varied by means of filters. Seated in a dark room the subject looks through the eye piece of the adaptometer. He is asked to report when a dim light flashes. The degree of his night blindness is indicated by the curve obtained by plotting the readings of the instrument taken at short intervals showing the minimal light which he can perceive. In the normal person the eyes become increasingly more sensitive and thus better able to see in the dark up to the end of about fifty minutes.

One of the tests for measuring sensitivity to glare is illustrated below. The person taking this test looks into one end of the box where he sees a miniature road scene. The lights from the car facing him are turned on and a measurement made of the amount of light necessary for him to see in the road scene the pedestrian in front of him on the right side of the road.

Persons who drive much at night should by all means have themselves tested for night blindness since it is difficult without being examined to tell whether one can see normally at night. Dr. Harold Jeghers of Boston University, who has made a special study of night blindness, summarizes the situation in these words:

Being an individual affair, automobile driving at night does not enable one to compare his skill directly with that of a person with normal dark adaptation. Hence many persons probably accept minor degrees of difficulty in night driving as the usual experience of all drivers. [135, *54*]

Recent studies have shown that improper diet plays an important part in making persons night and glare blind. [133, 134] The missing ele-

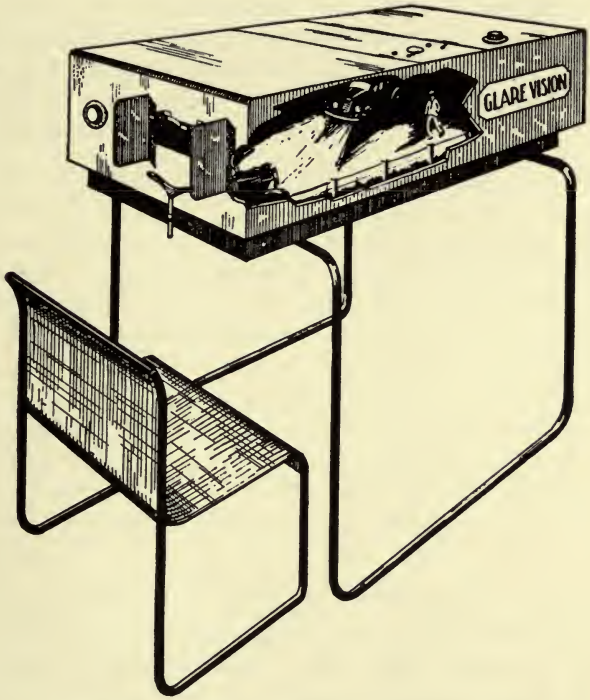


Fig. 20. Apparatus for testing sensitivity to glare.

ment in the diet of such persons is vitamin A, which is contained in abundance in cheese, butter, liver, and spinach. In many people glare and night blindness, when not arising from retinal pathologic processes, can therefore usually be cured by oral administration of concentrated vitamin A, or by change to a diet of foods rich in vitamin A.

Dr. Jeghers reports the following case history to show how the difficulties in night driving experienced by night-blind individuals may be overcome:

A 25 year old medical student had noticed difficulty in driving an automobile at night for six years. The ability to drive in daylight was unimpaired.

Trouble was noted with the onset of dusk; that is, before it was dark enough for lights to be used.

During the twilight hours the road markers and pedestrians (or anything requiring analysis of detail) were much harder to see. Most cars used no lights at this time, so that dazzling was not a factor. As it became darker, another situation appeared. The headlights of oncoming cars appeared unduly bright, and often so dazzling that nothing could be seen for several seconds after the autos passed him.

This was only mildly annoying on well-illuminated city streets. On dark country roads this dazzling often necessitated slowing down or stopping completely. While glare blind, driving was entirely by instinct since the road edge, fixed objects and pedestrians could not be seen. Trouble was also experienced playing golf in the evening, entering a darkened motion picture theatre, etc.

Several near accidents were experienced. Finally one night a dazzling light caused him to slow down, pull over to the side of the road and damage the car against a fixed object. At that time his visual acuity in good light was normal. After a month's vacation he resumed driving, and tried to compensate by driving slowly. A few months later, while dazzled by headlights he injured a pedestrian. There had been no night driving for the past four years except a few tries which convinced him that his difficulty still persisted.

The photometer test showed very poor dark adaptation. His diet contained only a fourth of the vitamin A content needed. This resulted from a poor selection of foods. Treatment with vitamin A and a change of diet completely restored dark adaptation to normal within two months. He now drives with ease at night and no longer experiences dazzling from bright headlights. [136, *46*]

McFarland and Forbes have shown that a decrease in the concentration of blood sugar lowers the ability to see after dark. The per cent of blood sugar is normally high after a meal and then gradually declines. This finding concerning blood sugar and night vision, if corroborated, would indicate that automobile drivers might see better after dark if they took measures to keep their blood sugar at a high level. [175]

There are indications that dark-eyed persons are less affected by headlight glare than are light-eyed persons. [82] The quantity and degree of pigment in the eye may be responsible for this difference. Negroes have been found to see better facing bright lights than white persons. [263] Albinos are blinded the most. [250]

Glare blindness increases with age. Young persons in their teens are least disturbed by bright light shining into their eyes, whereas with each added decade persons are more and more blinded by lights. [80, *27;* 14]

Night blindness is assuming a mounting importance both to our air corps and our army on account of their increasing use of planes and motor

vehicles after dark. Undoubtedly both will find it desirable to use as night pilots and night motor vehicle operators only those who by test have been found to possess normal night vision. [104, *442*]

The Relation of Night and Glare Blindness to Accident Susceptibility. Several writers have pointed out that night blindness plays a big role in automobile accidents after dark [103, 135, 136, 147], but little has been done to determine just how important defective night vision is as a factor in predisposing drivers to accidents.

The only figures on the relation of glare blindness to accidents are those obtained by the California study already referred to previously. It was found that seven times more individuals in the poor-driver group failed the glare test, than in the good-driver group. That defective glare vision among the poor-driver group played an important part in their accidents

TABLE 26

COMPARISON OF THE PERCENTAGES OF FAILURE OF GOOD AND POOR GROUPS OF DRIVERS ON GLARE TEST

(California, 1937)

	Glare Test
Good drivers	3.5
Poor drivers	24.0
Critical ratio	7.5

Source: Edwin D. Fletcher, *Preliminary Report on Special Tests,* Part I, pp. 5, 7 (mimeo). Department of Motor Vehicles, Sacramento, Calif.

is indicated by the fact that this group had 128 of their 174 fatal accidents at night.

Color Vision. Although among women color blindness is rare about 4 per cent of men are color blind to red and green when measured by psychological tests. Color blindness is of importance in driving, chiefly in so far as it affects the ability to recognize traffic lights. The color-blind individual usually either cannot recognize the red and green as such or else cannot distinguish the color until he is very much closer to the light than the person with normal color vision.

The best-known psychological test for this defect, the Ishihara test, consists of circles composed of groups of numerous small colored spots in which an individual with normal color vision sees certain numbers, but a color-blind person sees either no numbers or entirely different ones. Since this test is very sensitive and detects color-weak as well as seriously color-blind individuals, it is not commonly used at motor vehicle examining stations, which employ instead colored cards or lights.

Not all states have a color vision test for drivers; of those which do, most do not reject applicants because of color blindness but inform them of their defect and warn them to be careful at traffic lights.

In the long time he has been on the lookout, the author has never been able to find an accident which could be blamed solely on color blindness. Although there is little justification to refuse an applicant a license on account of color blindness, it does seem to be a good practice to call his attention to his defect and to note it on his record.

Tunnel Vision. The average person has a field of vision extending 90 degrees to either side. Such a wide field of vision is of value in driving because it enables one to notice cars and pedestrians approaching from the side. Some individuals, however, have a narrowed or restricted field of vision which permits them to see only straight ahead, just as if they were wearing blinders or were looking through a tunnel. Normalcy of peripheral vision may be determined without apparatus merely by having the person tested fixate an object directly in front of him, and then move a finger in from the right on a line with the eyes until he can just see the finger out of the corner of his eye. The left eye can be tested in the same way by moving a finger in from the left.

Restricted side vision is no doubt a source of accidents among automobile drivers. Although little is actually known about the part played by tunnel vision in accidents, cases have been reported of drivers whose entire field of vision extended only 20 degrees, and who could not see anything outside of this range with any amount of clearness. [106]

A driver with tunnel vision should turn his head more often to the right and to the left. He should be especially careful at intersections, and look carefully up and down the cross streets before entering. Serious cases of tunnel vision may eventually be shown to be dangerous enough to debar drivers from obtaining a license. Fortunately, the California Motor Vehicle Department finds that only a fraction of one per cent of drivers have restricted peripheral vision serious enough to affect their driving.

Hearing Tests. Not only the sense of sight but also that of hearing are of importance to the motorist. At many railroad crossings we still have to depend partly on hearing the shriek of the locomotive whistle or the clang of the signal bell to warn us of the oncoming train. At blind intersections in the city, too, the approach of another car is often indicated only by the noise it makes or by the blast of its horn. Needless to say, hazards of this type are doubly dangerous for deaf or partially deaf persons, who comprise perhaps 5 per cent of our population. They must be particularly careful to slow down and look at all intersections.

The horn is often used on the road to indicate to the car ahead the intention to pass. Deaf drivers present another risk here, for they may

not hear the horn of the car behind and may swing out to pass a car at the same time that a car behind is trying to go by them. If they do not hear the sirens of police cars, ambulances, or fire apparatus, they may obstruct the way and cause serious collisions.

It is not known whether deaf drivers are involved in more accidents, in proportion to their number, than are drivers with normal hearing, since there are insufficient reliable statistics on this point. That they are under suspicion is indicated by the fact that states are beginning to take cognizance of an applicant's hearing when issuing his license. Action on this point varies greatly from state to state. In some states a driver who appears deaf at the ordinary conversational level must equip his car with extra rear-view mirrors. He may be required to replace his small center mirror with a larger one and also to add outside mirrors on the left and on the right. The general tendency at present is to have the examiners deal with each case of apparent deafness on its merits. Some states send deaf applicants to a special examining board or to a special doctor. Some require that the fact of deafness be noted on the license for the information of the police.

Further research on deaf drivers should certainly be made, for their own protection as well as for that of the rest of the driving public. Efforts are also in order to determine how frequently deaf drivers are involved in accidents and whether their accidents can be attributed to poor hearing.

Deaf pedestrians appear to be still more of a risk than deaf drivers. Since deaf persons are not able to sense so well as the normal person the approach of a car without actually seeing it, they must make a special effort when crossing streets to look in both directions, and when walking along rural highways should take particular care to face oncoming cars. Just how much deafness is a factor in pedestrian accidents we do not know, but since a large percentage of pedestrian fatalities involve persons of advanced age, when deafness is much more common, there may well be a relation between the two.

THE USES AND LIMITATIONS OF DRIVER TESTS

When intelligence tests were first introduced they had their detractors and their overardent zealots. Having had a chance to observe the value of intelligence tests over a period of years we have learned to appreciate their value, and also their limitations. We find them useful in helping a skilled vocational expert in counseling an individual to avoid certain fields of activities where he will be unduly handicapped, but we do not expect them to predict an individual's success in life.

Driver tests, like intelligence tests, are of use in the hands of an expert, but by themselves driver tests should never be employed to predict success or failure in avoiding future accidents. The reason for this is that a driver's susceptibility to accidents depends not only on his skill, but also on his exposure, driving speed, and safety-mindedness. No test of skill can properly evaluate accident susceptibility unless it is supplemented with additional information about these other factors.

State road tests have been found useful for a variety of purposes: (1) to aid in selecting safe drivers and in weeding out accident-prone ones; (2) to aid in qualifying drivers for a state license or for employment; (3) to aid in diagnosing a driver's weaknesses and in determining whether he should be allowed to continue to drive; and (4) to aid in improving drivers.

Selecting Safe Drivers

Public officials as well as fleet operators have hesitated to use laboratory driving tests to aid them in selecting drivers until after they have been thoroughly investigated and proved effective in separating the safe driver from the accident-prone one. So far this hope of finding an easy way to tell the sheep from the goats has not been realized. No satisfactory composite test or battery of tests of skill has yet been devised which distinguishes clearly between accident-free and accident-prone drivers in individual cases.

But although no one has succeeded in devising a reasonably short unassailable test for differentiating between individual accident-free and accident-prone drivers, a number of investigations have shown measurable differences in the characteristics and performances of groups of these two types of operators. [80, 99, 105, 145, 259, 288]

Variables Affecting Test Performance and Accident Record. That various aspects of a driver's skill and his accident record are related when poor drivers are compared with good ones has been shown earlier in this chapter. No such correlation exists, however, in the large intermediate group of drivers, because in that group a number of variable factors tend to mask the relationship between test performance and accident record. [153, *259*] The most important of these variables are: (1) age, (2) experience, (3) exposure, (4) driving speed, (5) safety-mindedness, and (6) adequacy of accident reporting.

Age. Driving skill as measured by tests is most marked in young people and gradually falls off with age, making older drivers tend to be somewhat less proficient than younger ones. Susceptibility to accidents, however, is highest in young people and decreases with age, older drivers tending to have fewer accidents per mile driven than younger ones. Thus in determining the relationship between skill tests and accident-proneness, it is highly desirable to

compare drivers of similar ages. In this way the greater skill of young drivers which, presumably, should be a factor of some importance in avoiding accidents, will not be offset by other factors which may cause their higher accident rate. By keeping the age factor constant, it should be possible to determine the relationship between skill tests and accident susceptibility with considerably greater precision than is possible when a variety of important factors which vary with age are allowed to enter in. It is quite possible that a combination of these factors, some of which are mentioned below, may prove sufficiently important to outweigh skill losses which accompany increasing age.

Experience. Both skill and attitude change with driving experience. Thus in a mixed group of drivers some of whom are just beginning to drive and some of whom have had many years of experience, the experience factor may tend to color any relationship that may exist between original test scores of drivers and their accident records. To rule out this factor it would be desirable to choose drivers with approximately the same number of years of experience.

Exposure. A driver's exposure also plays a part in determining his susceptibility to accidents. The average commercial driver covers many more miles per year than the average private driver and, therefore, undergoes greater risk of having an accident. This mileage variable should be controlled by comparing groups of drivers with approximately the same exposure in terms of miles driven annually.

In addition to annual mileage, other exposure factors, such as the conditions under which a motorist does most of his driving, influence his susceptibility to accidents. Thus a motorist habitually traveling during the late hours of the day, or on highways crowded with other cars and pedestrians, is exposed to more driving hazards and is likely to incur more accidents than one who does most of his driving in the day time or on highways free from both foot and vehicular traffic. The type of exposure, as well as the extent, must be considered.

Driving Speed. Habitual fast driving may multiply the chances of an operator's having an accident. The speed factor in many cases may be of sufficient importance to counterbalance variations in skill. Thus a habitually slow driver may avoid accidents even though his skill may be seriously deficient. Drivers on scheduled operations, whose driving speeds are comparable, may be used as subjects in investigations of driving skill in order to keep this variable constant.

Safety-Mindedness. Although improper attitude or lack of safety-mindedness may be underlying causes of accident-proneness, no test has yet been devised to measure this quality satisfactorily. For the present, therefore, skill tests will have to be administered to individuals with widely differing degrees of safety-mindedness, although in many cases this factor may be of considerable importance.

Adequacy of Accident Reporting. No completely satisfactory procedure has yet been devised to determine the blame for an accident. Highly skilled and safety-minded operators may occasionally have accidents recorded against them for which other participants were entirely to blame. Moreover, since drivers with bad records are extremely anxious to avoid reporting their accidents, whereas drivers with good accident records have less reason to fear official scrutiny, the reporting and recording of accidents of poor drivers are probably less complete than those of good drivers. Since in any case state departments seldom have available complete accident records, errors arising from the use of this undependable criterion might very well offset any real correlation that might exist between tests of skill and accident-proneness.

Farmer and Chambers's Investigation of the Correlation of Driving Tests and Skill. Working with operators whose ages, years of driving experience and degrees of exposure were very nearly similar, Farmer and Chambers found that drivers who ranked high on tests of skill had considerably better accident rates than drivers who ranked low on the tests. [99] Between the 25 per cent of drivers who ranked highest in the tests and the 25 per cent of drivers who ranked lowest in the tests, significant differences in accident rates were apparent.

Difficulties in Controlling Test Variables. The fact that past investigations have not shown a close correlation between an individual's skill as measured by test, and his accident-proneness, does not, of course, prove that no relationship exists. Eventually, when all the variables which influence accident susceptibility are determined and controlled, we may find that the skill of an individual as measured by tests does correlate with accident-proneness. Farmer and Chambers have shown that when three of these variables—age, experience, and exposure—are controlled, the correlation between skill as measured by tests and accident susceptibility is more marked. It is, however, much more difficult and at the present, at least, next to impossible, to select a group of operators to whom to give tests of skill who have similar speed habits, safety attitudes, and dependable accident records. Although these latter factors are difficult to control they nevertheless play important parts in determining the accident susceptibility of motorists independently of age, experience, exposure and skill.

Need for More Research on Selection Tests. Careful studies of the validity of the various tests and batteries of tests available are badly needed. Some of the possible criteria for good or bad drivers which ought to be used to compare with the test ratings are: (1) personal ratings by experienced examiners; (2) degree of improvement as measured by examiner ratings before and after a standardized course of training; (3) the complete accident and violation record of the individual driver prior to the test; (4) his complete accident and violation record for, say, two years subsequent to the test; and (5) the cost of maintenance of vehicles similar to those driven by the examinee when used under equal conditions of exposure.

The criterion of rating by examiners is trustworthy only if the examiners are well trained. Unfortunately there are few examiners who can carry out a consistent and uniform job of rating individual driving ability, and who have observed a group of drivers long enough to know them sufficiently well.

The criterion of degree of improvement depends upon the administration of an efficient standardized training course, and upon giving a uni-

form road test before and after the training course. The improvement in rating before and after training should normally serve as a better criterion of good native driving ability than a single rating without regard to improvement.

But since the only direct measure of safety is ability to keep out of accidents, one of the best criteria of safe driving is the accident and violation record of the individual concerned. Unfortunately, young drivers, for whom selection tests are primarily intended, have seldom had sufficient driving experience to indicate adequately their accident-proneness. Hence a follow-up of their previous accident experience although highly desirable is seldom of much value in indicating their accident susceptibility.

With similar year-model vehicles and comparable exposure, the cost of maintenance of different drivers' vehicles gives a rough indication of their overall ability. For as truck owners have long known, the operating cost of vehicles driven by skillful, dependable drivers is consistently lower than for those handled by less skillful ones. In addition to the cost of repairs from accidents, it is found that the cumulative wear and tear on a vehicle operated by a poor driver is more than for that of a good driver. Hence the cost of maintenance of the vehicle an operator drives could be used as a criterion of his fitness as a driver.

Future investigations to determine the correlation between skill and accident susceptibility should give careful consideration to the factors mentioned above (age, experience, exposure, driving speed, safety-mindedness, adequacy of accident reporting), and to the choice of a dependable criterion against which to test the validity of skill tests in differentiating accident-free from accident-prone drivers. A convincing, authoritative research program for the validation of tests to select safe drivers will be anything but simple and inexpensive.* But such a program though costly if well planned so as to avoid the mistakes of the past would be indispensable in checking the validity of available selection tests, and in furnishing needed information to guide us in devising more effective tests.

Even years from now the improved tests for selecting drivers which will then be available will by themselves be unable to predict accident-proneness for skill after all is only one of the factors which determines safe driving. As to how important skill is among all the factors which

* An important reason why such a program has never been carried out is its expense. For example, a recent estimate by a federal agency of the cost of a program of testing drivers, looking up their accident records, and carrying out the necessary statistical work to evaluate them intelligently, revealed that it would come to approximately $6 per driver. Since a minimum of a few thousand drivers is needed it is easy to see why research of this type is not more common.

influence a person's susceptibility to accidents shall have to await the results of further research to give us the answer.

Qualifying Drivers

It is a generally accepted theory in America that anyone can learn to operate a motor vehicle satisfactorily if he practices long enough. The truth of this statement is evident from the ease with which we permit a person to obtain a license. The state driver license examination is almost entirely a qualifying test intended to indicate the level of achievement, or the amount of practice the applicant has had. It is not really a selection test in the sense of its serving to weed out the potentially less capable or accident-susceptible driver, since practically everyone who desires a license eventually obtains it if he is willing to practice enough to pass the road test. For although in addition to the road test the typical license examination includes a vision test, knowledge test, and road-sign test, the proportion of rejections for these latter tests is very small on the first examination and dwindle to practically nothing at all on the first and second re-examination (see Chapter XIII). When, however, hesitant state authorities get a clear mandate from the public for administering a stricter driver examination we may expect that a new lease on life will be given to research on improving our tests for qualifying drivers.

State Road Tests. As will be seen from Figure 21, all but 15 states require new applicants for the driving license to take a road driving test. There is much to be said for a practical road driving test provided it is administered uniformly and impartially. The great difficulty with this kind of test is that some state license examiners, since they are not properly trained, do not administer it in a uniform way.

All too often state examiners acquire habits of looking for one weakness which often has little to do with driving a car safely, and of failing the applicant for that one deficiency. For example, certain examiners reject applicants solely for lack of skill in parking, failure to give a hand signal, or an awkward start on a hill, regardless of an otherwise good performance, and some examiners, on the other hand, are too easy on applicants.

Bribery of examining officers has in certain localities also entered into the road test picture. Motor vehicle departments are on the alert against such nullification of their regulations, and are anxious to punish offenders, but if the general public expects incapable drivers to be kept off the road, it must also do its part by reporting dishonest examiners.

If examinations for a license are worth giving at all, they are worth giving efficiently and uniformly. An easy, carelessly administered exam-

ination actually does harm since an incompetent person passing it emerges with the belief that he is a properly qualified, safe driver. If, on the other hand, an applicant is unable to procure a license until after he has learned to drive skillfully and carefully, he will be impressed with the fact that only competent drivers are privileged to possess licenses.

Diagnosing Drivers

Police departments have found tests of skill very effective in diagnosing driver defects. [78] To be of greatest use, however, the data from tests

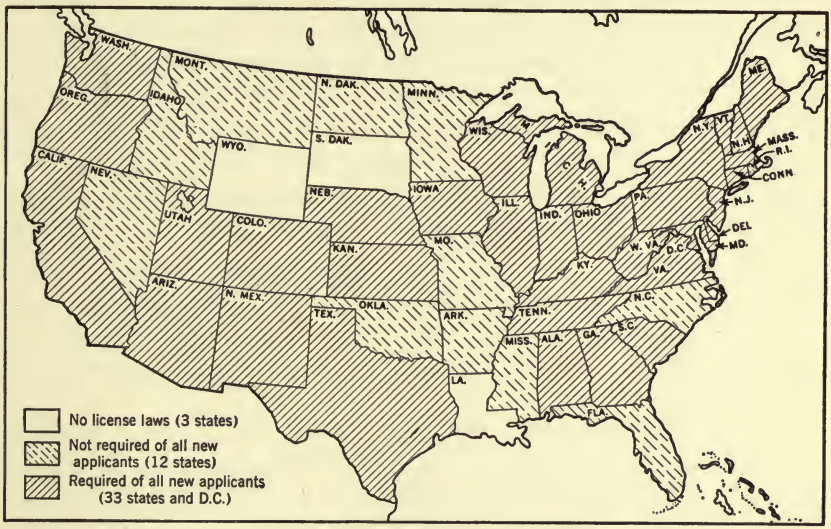


Fig. 21. States requiring road test of all new applicants for a driver's license. Source: *Minimum Driver License Examination Standards*, p. 14. American Association of Motor Vehicle Administrators, 1939, Washington, D. C.

of skill must always be supplemented by other information gathered from other sources.

One of the most comprehensive attempts to diagnose driver defects is that by Dr. Selling who has been examining each year a limited number of especially flagrant traffic offenders picked out for him by the judges in the Recorder's Court, Detroit. Dr. Selling, in addition to tests of skill, gives each of his subjects a thorough medical examination, and from a personal interview compiles a short biography. He finds that physical, mental, and emotional defects indubitably contribute to the depressing records of his subjects. [242, 251, 252, 253, 254] Two German investigators also emphasize the part played by nervous and mental diseases in

accidents. [172, 285] The promising work by W. H. Sheldon of Harvard in analyzing human personality, as outlined in his *Varieties of Human Physique*, ought eventually to be applied with profit to the problem of selecting automobile drivers. [257]

Improving Drivers

The last but far from the least important application of driver tests is their clinical use to educate and to improve drivers (see also Chapter XIII).

Several investigators have reported a marked lowering of the accidents of drivers subsequent to their being subjected to a battery of tests. [75, 80, 105, 107, 259] The validity of such improvement, however, has been questioned. [138, 139] But if the driver tested is also interviewed, his shortcomings pointed out, and ways and means of his avoiding future accidents discussed, he can scarcely help but be benefited. [78, 226]

One of the most successful applications of tests for the improvement of drivers was made by Bingham and Slocombe on the Boston Elevated Railway Company bus operators. In 1927 the collision accident rate of buses was 2.1 per 10,000 vehicle-miles, but in 1929 this rate was reduced to 1.5 collision accidents per 10,000 vehicle-miles as a result of individual supervision of bus drivers, including improved driving diagnosis and treatment.

The use of driver tests at fairs, automobile shows, and at other public gatherings where the emphasis is on entertainment and advertising, on the other hand, has little if any constructive value, for the beneficial effect of driver tests in an educational sense is almost directly in proportion to the competence of the examiner and the time he spends interviewing the person tested. The perfunctory testing of drivers for the sake of publicity is to be deprecated. The considerable sums of money so expended could be spent much more effectively for safety in a number of other ways.

NEED TO CONTINUE TO IMPROVE AND USE MORE EFFECTIVELY THE TESTS WE HAVE

Although present tests of driving skill are admittedly far from perfect, we have failed to make nearly as much use of them as they deserve, for skill is undeniably of importance in driving. We need to use driver tests to help us in studying the abilities necessary in driving a car, to assist us in improving the quality of new drivers, to aid in diagnosing and improving the drivers already licensed, and to help in disqualifying insufficiently

trained drivers as well as those who have little native ability to handle a car.

A really thorough analysis of all the various factors which go to make up driving skill has never been made. Such analysis should be carried out scientifically and new tests devised to measure the hitherto neglected aspects of driving skill.

License tests such as those prescribed by the American Association of Motor Vehicle Administrators, which require all applicants for the driver's license to show a high standard of practical driving ability, normal vision, and a knowledge of traffic rules and good driving practices, are serving a very important function in raising the standards of driver training requisite to the issuance of a license. But much more remains to be done to extend strict tests for drivers to all states.

Similar tests would be equally valuable if required periodically of all licensed drivers, say every five years. The use of driver re-examination tests gives drivers an incentive to improve, as well as furnishes them with valuable information about their own shortcomings. Re-examination tests are also useful to give to persons who have had accidents or committed violations.

The selection of drivers by bus and truck companies and by our armed forces is still being done by rule-of-thumb methods. [83, 229] Although some excellent preliminary work has been carried out [79, 99, 259], the importance of the results which could be obtained from an improved scientific selection of commercial and military drivers would seem to justify much more extensive work along this line. [18, 88, 98, 145, 155, 183, 271] Particularly to be desired are studies on military drivers. Although efficient truck and tank drivers are vitally necessary to the Army, at the time of writing the Army has done little or nothing toward improving its drivers, whereas the Air Corps in collaboration with the best research specialists in our universities is fast developing a system of incomparable excellence for the selection and training of its pilots.

CHAPTER V

SAFETY-MINDEDNESS

RELATION OF SAFETY-MINDEDNESS TO OTHER FACTORS AFFECTING ACCIDENT SUSCEPTIBILITY

Last but not least in importance of the four basic factors which influence a driver's susceptibility to accidents is *safety-mindedness.* By safety-mindedness we refer to the attitudes which lead a driver to try to keep out of accidents.

As we have seen from the preceding chapters, the hazards accompanying driving increase with greater exposure and higher speed. The more one drives in hazardous zones and at dangerous hours, and the faster one drives, the greater become one's chances of having an accident.

Skill also plays an important part in accidents as we have just discussed in Chapter IV. Yet in testing operators the author has encountered numbers of persons who have been able to drive safely over a period of years even though their driving skill was below average. The outstanding characteristics of all these motorists were the possession of an insight into their deficiencies and a willingness to restrict their driving so as to make up for their weaknesses.

Although youthful drivers in their early twenties rate higher than older drivers in their ability to manipulate a car, they have poorer accident records, proving that *skill by itself is not enough.* The driver who can go for years without accidents must in addition to skill possess something which, for want of a better word, we have termed safety-mindedness. Thus a young, skillful driver may take unnecessary chances and incur accidents, whereas a less skillful, but more safety-minded, older driver, in appreciation of the danger and his own limitations, may exercise greater caution and thereby avoid trouble.

WHAT IS SAFETY-MINDEDNESS?

Safety-mindedness is a complex state of mind involving a recognition of the inherent hazards of driving and their relation to the lives of those who use the roads. Among its basic constituents are caution and consideration for the lives, property and comfort of others. Other traits that

contribute to safety-mindedness are foresight, emotional stability, mental balance, and a desire to understand one's limitations as a driver with a view to surmounting them.

Development of Safety-Mindedness Influenced by Knowledge of Accidents

A driver's development of the safety sense is naturally influenced by his connection with the problem of automobile accidents. If an intelligent driver reads the current articles and books on highway safety he cannot help but be affected in his attitude toward driving by the background of information about accidents which he acquires. But although the reading of articles like "And Sudden Death" may make him pause, witnessing or participating in an actual accident has a more lasting effect, particularly an accident in which someone suffers or dies. Accidents in which one was a driver naturally also make a deep impression. And those in which one, or a member of one's family, is injured are particularly hard to forget. So much does participation in an accident affect many sensitive middle-aged persons that when they have been involved in fatal or personal injury accidents they acquire a permanent distaste for driving. The other side of this picture, however, is that the unpleasantness of automobile accidents causes most of us to offset it by repressing remembrances of them. Although this forgetting has the advantage of aiding us to preserve our peace of mind, it also has the disadvantage of predisposing us to continue to drive in a carefree manner, and to ignore the fact that highway accidents are a social problem calling for solution.

LESS SAFETY-MINDED TYPES IN OUR POPULATION

Twenty years ago the use of the automobile was limited to the upper economic classes of our society. Now with the improvement in our national standard of living and the increasing popularity of the motor car, one out of approximately three persons in the country has become a driver. Instead of the million drivers of 1919, we now have 40 million.

This tremendous increase in the proportion of our population driving cars has naturally resulted in larger and larger numbers of our less fit citizens taking up driving. Although cheap automotive transportation has been a boon in many ways to the average American it has put behind the wheels of cars a large number of individuals who are not up to par physically, mentally, or emotionally and who consequently cannot be expected to possess all the characteristics necessary for safe driving.

Relation of Social Background and Safety-Mindedness

Safety-mindedness is a reflection not only of specific driving knowledge and experience but also of one's attitude toward life and one's fellow man.

We all have certain responsibilities as members of our respective communities. Our ratings as desirable or undesirable citizens depend to a considerable extent on the way we fulfil these duties, or expressed differently, on our degree of social responsibility. Since safety-mindedness is based partly upon the very qualities that determine whether we are assets or liabilities to society, it follows that safety-mindedness is correlated with our status as citizens. Decent behavior on the highway may be in part a reflection of one's general respectability.

Although some of our basic traits are inborn, the ability and willingness to adjust ourselves to society depend to a large extent upon our environment and training, or what is commonly referred to as our "background." The personal qualities which determine our degree of social adjustment naturally are influenced by and vary with our social status and the standards of social behavior it presupposes.

Individuals who have been brought up in favorable surroundings where they have had the opportunity to learn how to behave as cooperative members of the community, to obey the laws, to earn a living honestly, and to respect the rights of others, acquire a normal sense of social responsibility, whereas individuals who have grown up in unfavorable surroundings where considerations of self-survival are all important and education and the civic virtues neglected, frequently fail to acquire a normal sense of social obligation. This, in turn, makes difficult the development of a safety-minded attitude when they become drivers.

The relationship between undesirable social phenomena and bad driving has not been much studied because bad driving has always been regarded as a problem to be solved principally by improvements in the roads and cars, or by general propaganda and safety education in the schools.

Relation Between Poor Living Conditions, Crime, and Safety-Mindedness

Experts in various fields have testified that there is a very considerable causal relationship between living conditions in substandard areas in cities, and disease and crime. Crowding, defective sanitary facilities, improper ventilation, and inadequate heating do not make for physical well-being, nor in turn, for moral health.

Studies in a number of cities throughout the country confirm the connection between squalid living conditions and delinquency. [298] In Jacksonville, Florida, it was found that 32 per cent of all major crimes and 42 per cent of all sex crimes were committed in a slum section embracing less than 1.8 per cent of the city's area. In Cleveland, Ohio, and Philadelphia, Pennsylvania, the rate of juvenile delinquency was found to be three times as high in the underprivileged areas as it was in the rest of the city. In Hartford, Connecticut, and Birmingham, Alabama, it was twice as high. In a tenement area in Chicago, more than 25 per cent of all the boys between the ages of ten and seventeen passed through the juvenile court in one year. In Detroit, according to studies there are fifteen times as many criminals in slum areas as in normal residential districts. [84]

Two important elements of safety-mindedness—responsibility and consideration for others—need development through education and good example. Slum conditions do not facilitate their growth. The struggle there for the bare necessities of existence and for even a tiny portion of luxury makes the rule of life "everyone for himself," a principle which by its very nature excludes consideration for others and responsibility toward society in general. Persons who have had to contend with so many adverse factors, especially if they have little mental and ethical capacity, find it hard to adjust themselves to society, and, accordingly, to the other drivers on the highway.

Studies of Sociological and Economic Factors Affecting Safety-Mindedness

A traffic survey in Saint Paul, Minnesota, in 1937–1939 revealed that the proportion of licensed drivers in accidents is much higher in some districts than in others, and that the census tracts having the highest proportion of the drivers in accidents were located in poorer portions of the city surrounding the downtown business section, where the residents were generally of the lower-income group. [246] In these high-accident districts one out of every 12 or 13 drivers was involved in an accident during the year, as compared to an average of one out of 21 drivers for the city as a whole. The lowest rate of accident participation was for drivers residing in residential areas on the outskirts of the city where people of the higher-income groups reside. Only one out of 30 to 35 drivers in these better residential areas was involved in an accident.

The table below shows that in census districts of Saint Paul where there was a large proportion of old cars the percentage of licensed drivers in

accidents was relatively higher than in the districts with a low proportion of old cars. For example, in 1938 in those districts where 60 per cent or more of the vehicles were over five years old, it was found that 6.8 per cent of the licensed drivers were involved in accidents, whereas in those well-to-do areas where less than 30 per cent of the vehicles were over five years of age, only 3.6 per cent of the licensed drivers had accidents. It would seem therefore that at least in large cities like Saint Paul, low economic status, old cars, and high accident frequency go together. Old cars are usually not so well maintained as newer ones, which may be another accident-provoking factor.

TABLE 27

ACCIDENT INVOLVEMENT OF DRIVERS COMPARED WITH THE PROPORTIONS OF OLD VEHICLES IN THEIR DISTRICTS IN SAINT PAUL, MINNESOTA (1938)

Percentage of Automobiles Over Five Years of Age	Licensed Drivers in Corresponding Districts	Licensed Drivers in Accidents	Percentage of Licensed Drivers in Accidents	Licensed Drivers per 100 Registered Motor Vehicles
Under 30	27,529	1,000	3.6	188
30–39.9	18,222	679	3.7	177
40–49.9	36,313	1,819	5.0	179
50–59.9	28,180	1,507	5.3	176
60 and over	12,041	821	6.8	179
Total or average	122,285	5,826	4.8 (Avg.)	180 (Avg.)

Source: Adapted from figures in *Street Traffic Conditions, Saint Paul, Minnesota, 1937–1939*, pp. 146–148, Appendix 1, 1939. Department of Public Works, Saint Paul.

Since, as is shown elsewhere (Chapter VIII), old vehicles travel fewer miles per year than new vehicles, it seems likely that the accident rate of Saint Paul residents in districts with high percentages of vehicles over five years old is even higher on the basis of miles driven than when measured on the basis of accidents per driver.

In 1938 an identical study was carried out in Detroit, except that for the districts studied the ratio of accident-participating drivers to the number of registered vehicles (instead of to number of licensed operators) was determined. [85] Figure 22 illustrates the variations in distribution of accident-participating drivers per vehicle throughout the city.

The largest (black) area with a high concentration of accident drivers constitutes one of the worst slum areas of greater Detroit. In parts of this section drivers representing over 40 per cent of the total registration of

automobiles were involved in accidents during the year. Contrast this with the figures for some of the other tracts in good neighborhoods, where the drivers who had accidents represented as low as 5 per cent of the registered vehicles.

Generally speaking, in Detroit the proportion of drivers in accidents decreased as the neighborhood improved. Accident participation was

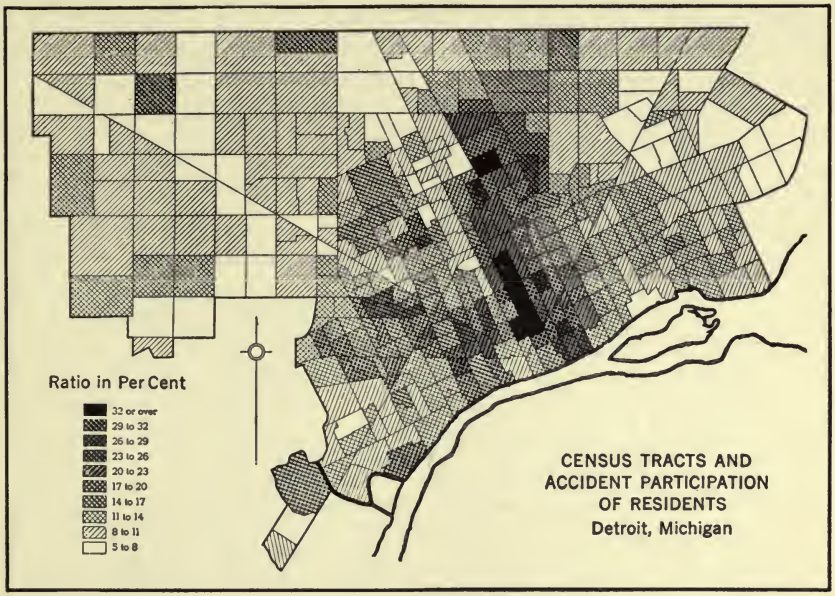


FIG. 22. Ratio of accident-participating drivers to motor vehicle registrations by census tracts in Detroit (1935, all accidents).

Source: *Street Traffic, City of Detroit, 1936–1937*, p. 239. State Highway Department, 1937, Lansing, Mich.

least prevalent in the well-to-do districts, and was most common in substandard areas.

A Louisville, Kentucky, report gave similar results to those in Detroit. [161] Figure 23 illustrates the ratio of the number of accident-participating drivers to the number of registered vehicles in the census districts in that city.*

* A criticism of the Detroit and Louisville studies is that they did not obtain figures on the ratio of accident-participating drivers to all licensed drivers in the census districts as was done in the Saint Paul study. But if the Saint Paul figures (see Table 27), showing that the ratio of drivers per vehicle was about the same or slightly higher in low-accident districts than in high-accident districts, are typical, then it would seem that in Detroit and Louisville the ratio of accident-participating

The low-accident areas in the eastern section of the city are inhabited by the more successful citizens of higher economic and social standing. The highest-accident areas, in the north central and northwestern portions of the city, contain a considerable proportion of poorly educated, low-income citizens, many of whom are living under slum conditions.

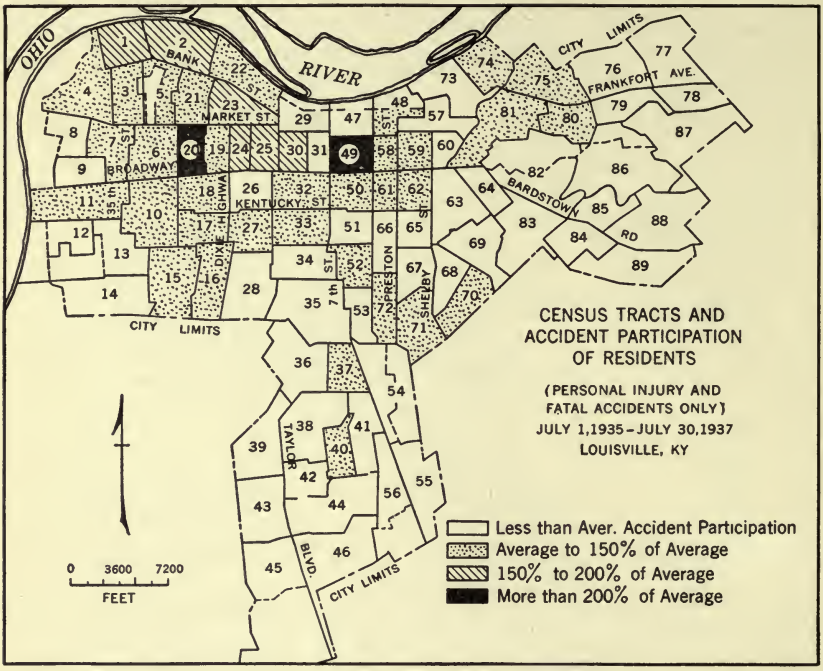


FIG. 23. Ratio of accident-participating drivers to motor vehicle registrations by census tracts in Louisville (1935–1937, personal injury and fatal accidents only).

Source: *Traffic Planning Report, Louisville, Kentucky, 1937–1938*, p. 117. Jensen, Bowen, and Farrell, Ann Arbor, Mich., 1938.

All the census tracts on the above map showing over 150 per cent of average accident participation are in areas of the city where monthly rentals of less than $20 are the rule. Rates for the different census tracts grouped according to prevailing rentals are shown in the table below. It will be noticed that the number of accident drivers per vehicle is highest in the lowest rental districts and decreases as rentals rise.

drivers to registered vehicles ought to correspond quite closely to the ratio of accident-participating drivers to all drivers. At any rate the Saint Paul figures indicate that the larger proportion of drivers in accidents in high-accident districts cannot be attributed to a higher ratio of drivers per vehicle in those districts.

TABLE 28

REGISTERED VEHICLES, DRIVERS IN ACCIDENTS AND THEIR RATIO TO REGISTERED VEHICLES

(Classified by average monthly rentals in individual census tracts in Louisville, Kentucky, 1937–1938)

Average Monthly Rentals of All Dwelling Units [1]	Registered Vehicles [2]	Drivers in Accidents [2]	Accident Drivers per 100 Registered Vehicles
$75 and over	481	9	1.9
$50 to $74.99	6,292	235	3.7
$40 to $49.99	2,754	150	5.4
$30 to $39.99	8,592	492	5.7
$20 to $29.99	14,287	811	5.7
Under $20	24,371	1,603	6.6

Source: 1 Information concerning monthly rentals by census tracts received from Municipal Housing Commission, Louisville, Kentucky.
2 Adapted from figures in *Traffic Planning Report, Louisville, Kentucky, 1937–1938*, p. 115. Jensen, Bowen, and Farrell, Ann Arbor, Michigan, 1938.

These studies, indicating that in the lower-income and slum districts there are proportionately more accident-participating drivers and vehicles than there are in the higher-income districts, have opened up a new vista of problems which deserve further study. For example, it would be desirable to gather information on the driving experience, sex, age, race, and educational status of operators and pedestrians in accidents by census districts, and compare it with similar data on all drivers in those districts. It would be interesting to compare districts according to reported causes of accidents, types of accidents, locations, times of occurrence, circumstances surrounding those accidents, and by the year model, type, and condition of vehicles involved. It would be valuable to have a group of the worst offenders from good and poor districts report to be interviewed and subjected to a battery of medical and psychological tests in an effort to discover underlying factors which might have predisposed them to accidents, and to detect differences in human deficiencies contributing to accidents among different classes of citizens. An attempt should also be made to check what part, if any, of the good record of citizens in the better districts can be attributed to their ability to pay for their mistakes, and to keep information about their accidents from the press and from public records.

A Study of the Social Attitudes of Bad Drivers

As we have shown, squalid districts with their characteristic type of population have more delinquency. These same sections also have the highest automobile accident rates. This relationship between defective citizenship and dangerous driving is borne out by a comparative study of the social characteristics of good and bad drivers. [72] When a random selection of drivers was compared with a group of drivers who had been involved in accidents or convicted for speeding or reckless driving, it was found that the random group were more often members in good standing of the Chamber of Commerce; they had better credit records with retail concerns; more of them contributed to the Community Chest, and they made more contributions of over five dollars than did the bad-driver groups; more of the random group of drivers were registered voters and more of them voted in the primary and general elections; they had fewer criminal convictions. Social traits such as these, all of which are associated with good citizenship, seem to be related to safety-mindedness.

The "Goodness" of Cities as Indicative of Their Accident Rates

In a very interesting study of various characteristics which distinguish communities with high living standards from those with low, Edward L. Thorndike points out that the average deaths from automobile accidents per hundred thousand population in the 10 "best" cities in the United States was 23.3 as against 40.7 for the 10 "worst" cities. [274, *49*] In other words, cities with a high standard of living have fewer automobile deaths than those with a low standard of living, just as in the studies mentioned previously, good districts in a single city were seen to have fewer accident drivers than poorer districts.

Thorndike has very cogently shown that although the "goodness" of a city is correlated with its economic status, nevertheless, in two cities with the same economic status, one may have a very much higher "goodness" rating than the other. Equally as important as standard of living are the people themselves—their intelligence, industry, character, and family life. So it is only fair to point out that there are always some persons who, though belonging to the more prosperous classes, turn out to be incorrigibly irresponsible drivers, in the same way that there are those who, with good background and schooling, become criminals. It should be mentioned here, too, that safe driving records are not confined to privileged citizens. Many a man who has had to combat the handicaps of low economic, social, and cultural surroundings makes a success of his driv-

ing. In general, however, favorable environmental influences help to make better drivers just as they have been shown to produce better citizens.

The Non-Owner-Driver

The majority of male adults of average income drive their own cars. Those who do not own the cars they drive are, with the exception of commercial drivers, principally less-privileged citizens or young people who cannot afford to own and operate vehicles.* We should naturally expect motorists who own the cars they are operating to drive them more carefully and incur fewer accidents, and this seems to be true.

A study of all Connecticut drivers in accidents shows that non-owners incur about 50 per cent of the accidents. [56] Since there are only 120 licensed drivers to every 100 vehicles in Connecticut there can scarcely be more than 25 per cent of the drivers who are non-owners, it being assumed that the owners of most vehicles are licensed drivers. In another study of fatal accidents incurred in various states by 983 drivers, those who were non-owners were found to incur 45 per cent of the accidents. [5, *368*] Moreover, since non-owners as a group do not average any higher annual mileage than owners [76, *94*], their accident rate per miles driven as well as their accident rate per licensed driver seems higher than for owner-drivers.

If the studies reported above are corroborated it would seem that non-owner-drivers are more accident-prone than owner-drivers and that special efforts should be made to keep their accidents in check. It is unfortunately true that non-owner-drivers and motorists with low economic status who have high accident rates seldom carry liability insurance.

The Foreign-Born and Illiterate Driver

Foreign-born and illiterate drivers present a special problem to the highway safety worker. Some preliminary and unconfirmed studies made by the author have shown that foreign-born persons, of whom there were approximately 13 million in the United States in 1930, form a larger percentage of accident groups than do those who have been in this country longer, and that among the foreign-born are more accident repeaters. [80, *52*]

Many foreign-born persons find it difficult to master the new language; some never do. This ignorance of the common idiom makes the reading

* Women who drive the family car registered in their husbands' names are practically part owners in that they have a vital interest in the car, even though it is not legally theirs.

of traffic signs and the understanding of motor vehicle laws difficult. The newcomers' unfamiliarity with American customs also makes it harder for them to make a living, thus keeping them in the lower-income brackets, and consequently, in less favorable environments. These handicaps do not enhance their chances of becoming safe and efficient drivers.

Illiterate members of our population, who in 1930 were estimated to number nearly 4 million, are in much the same situation. Being unable to read current literature, not even the newspapers, they do not comprehend the gravity of the accident problem; safety education leaves them entirely untouched. Since illiteracy is a sign of unfavorable environment, and often of mental inferiority, we should not expect illiterate individuals to rate high as drivers. The relation between accident-proneness and educational status is indicated by the observation that the education of groups of accident drivers averages two or three years less than that of groups of unselected drivers. [80, *53*]

The Emotionally Unstable or Mentally Diseased Driver

Several investigations conducted of violator- and accident-drivers reveals the presence in their midst of a surprisingly large number of emotionally unstable and mentally diseased drivers. [252, 256]

Mental instability frequently goes hand in hand with inefficient coordination of muscles and bodily movements. An unbalanced emotional system may show itself outwardly in jerky or uncertain actions. No matter how slight such movements may be or how harmless in other situations, they may have serious consequences when they occur in a driver traveling at high speeds.

Emotional instability may occur in any class of citizen, although its manifestations may vary in different social groups. Emotionally unstable people from the slums are apt to show this defect in acts of aggression on the road, whereas those from the better sections are more likely to err in the direction of timidity and uncertainty. To those whose lives have always consisted of insecurity, the risks of the road mean less than they do to conservative persons from the middle and upper classes, whose more sheltered life has given them a different conception of personal danger.

The Criminal Driver

No studies have ever been made of the driving records of the estimated 4,750,000 criminals in the United States.* Obviously, since asocial be-

* Figure by the Federal Bureau of Investigation. It includes murderers, thieves, burglars, embezzlers, arsonists, kidnappers, etc.

havior and the absence of feelings of social obligation are characteristic of criminals, we should not expect them to show consideration for the rights of others while driving. A man who would appropriate your money, burn your house, or take your life without compunction will naturally not be much concerned for your safety on the road. Neither will an operator of one of the 180,000 stolen cars reported in this country annually.*

THE SAFETY-MINDEDNESS OF THE NORMAL DRIVER

A driver with a previous fine driving record may be involved in an accident through his own mistake, then continue to drive safely for years. Many examples of this type of driver will be found among the privileged citizens whose sense of social responsibility is unquestioned. This brings up the question, "Why do our normal citizens have accidents?"

A normal driver may, of course, be involved in an accident for which he is entirely blameless. The cause may have been the fault of some other driver, or else the coming off of a wheel. The proportion of such accidents in which the drivers were unable to do anything in the way of avoidance is believed to be very small. Nevertheless it must be admitted that a certain number of drivers are involved in accidents which are really "accidental" in the sense that they were powerless to avert them.

As for the great majority of accidents, in which the driver was at least partially to blame, basic faults that lead the ordinary, well-meaning citizen to get into trouble are his *ignorance* of his own and his car's limitations, and his failure to study and anticipate the different kinds of hazards encountered on the roads in the vicinity of his home. But in addition, correct *attitudes*, especially toward other users of the highway, and the ability to anticipate and avoid the effect of *temporary indispositions* on one's driving, are crucially important in keeping a motorist out of trouble.

Knowledge of Self, Vehicle, and Road

Few drivers are perfect. Most of us have certain handicaps—such as deficient training, skill, sensory capacity, or faulty attitude. Nearly all these limitations can be corrected or compensated for provided we are aware of them. Thus, to take a sensory defect as an example, many a driver whose sight is perfectly normal in the daytime suffers after dark from night blindness or glare blindness (see Chapter IV). Not being

* The Federal Bureau of Investigation gives 188,203 as the number in 1938.

conscious of his defect he drives at the same speed at night as does a person with normal night vision, sometimes with disastrous results. Once such a handicap has been pointed out to the individual who possesses it, he may take corrective measures to improve his night vision, or else compensate by driving slowly and as little as possible after dark.

A knowledge of the defects which may appear in cars either from normal aging or from faulty maintenance is also important. A driver is helped in a number of ways by a thorough understanding of the mechanical construction of his vehicle. First of all, it aids him in handling his car more intelligently. Secondly, it encourages him to watch for signs of failure and to keep it in first class condition. Thirdly, it gives him more confidence by dissipating the feeling that the car is a mysterious machine which may do unpredictable things.

The average motorist would also benefit from a clearer grasp of the hazards which he encounters on the roads in the vicinity of his residence where he does most of his driving. A study of the safest route between his home and place of business and the time he should allow to negotiate it without haste under all conditions of traffic would amply repay him.

Attitudes Promoting Safety

Many socially responsible citizens fail to adapt themselves to driving on the highway because they have not learned to avoid taking chances there. We all have to take some chances of colliding with objects when driving but some drivers deliberately take many more risks, expecting other drivers to yield the right of way. Such "risk-prone" drivers may take many chances before they cause an accident, but in the long run, other things being equal, they are bound to incur more accidents. [87]

The safe driver learns to adopt a sportsmanlike attitude toward other users of the road, and in particular to compensate for the bad habits of other motorists, by *driving defensively*. Let us briefly review some of the more important actions of the defensive driver.

On reaching an intersection when the green light is showing, the defensive driver does not speed up but slows down or continues at a moderate speed. If the light turns yellow he asks himself, "Can I stop safely where I now am?" and not, "Can I beat the other fellow through the intersection before the red light appears?"

At blind intersections the defensive driver never insists on his right of way if there is the slightest risk of an accident in so doing. He refuses to drive fast through an intersection, and never fails to notice other cars, regardless of whether in a technical sense he has the right of way. He

recognizes that no version of the right-of-way rule authorizes negligent or blind driving.

Further, the defensive driver realizes that "being in a hurry" is an emotional attitude that makes a person more susceptible to taking chances, and starts in sufficient time to reach his destination without exceeding the speed limits. The very availability of speedier motor vehicles and speed-inducing highways has unfortunately inclined us to continue to shorten the time of traveling between our homes and our destinations. And we need to resist our American urge to "go places in a hurry" and to "get ahead of the man in front."

In contrast with the person who can rarely keep out of accidents very long because he tries to pass everyone on the road, the defensive driver does not worry about how many people get ahead of him. He drives to arrive at a destination, and although keeping abreast of traffic, does not allow himself to be lured into useless competition with speeding drivers, nor permit himself to be emotionally aroused by discourtesies on the part of other operators.

When another driver is trying to pass him the defensive driver never increases his speed. He keeps to the right and courteously gives the passing car ample room to get by. Whenever he does go by another car he waits until he has sufficient passing distance, and then goes ahead without faltering. He remains in line in heavy traffic and never passes on hills, curves, or at intersections.

Ambitious young male drivers are inclined to allow their "push" to carry over in their motoring. They assume an "offensive" attitude toward other drivers, not realizing that they cannot eliminate other drivers from the road, no matter how much pleasanter their own driving would be without them. Rushing around in their cars for the thrill of it, particularly at night to impress their girl friends, they commonly drive too fast for conditions.

But prosperous middle-aged males as well as young ones are guilty of faulty attitudes. Thus successful government executives who rule with an iron hand, business magnates who tyrannize their subordinates, physicians who are accustomed to domineer over their nurses and patients, college professors who intimidate their students, and ministers who lord it over their congregations, tend to assume in driving the same attitudes toward other users of the highway that they adopt toward those surrounding them. Similarly, certain high-salaried industrial leaders and movie stars whose time, according to their income tax returns and in their own estimation as well, is incalculably valuable naturally make a point of not wasting it on the highway. The pace of the average driver is not fast enough for them. They feel they must lead the parade.

All this is not to say, however, that everybody can be expected to govern his driving reactions like the motorists in the following episodes:

On a narrow winding road, John Q. Fuller was forced to stay behind an antiquated jalopy that was averaging eighteen miles per hour. After twenty-two minutes of this, Fuller remarked to his companion, "I don't mind these guys that crawl along in the middle of the road; it's the fast reckless drivers that get my goat."

On a very sharp, blind curve, Jerome G. Lawlor suddenly encountered a car parked halfway out in the road on the very sharpest part of the curve. Lawlor jammed on the brakes, swung out, barely missed the offending vehicle, and proceeded on his way, never remarking, "He picked a swell place to park."

When Walter G. Weaver returned home from a hard day at the office, he was informed by his wife that she had seriously dented the fenders of the family car on their garage door. Weaver let out a horrible oath, and remarked, "Those damn doors are too narrow! I'm always bumping into them myself."

Harvey T. Pratt, driving at night, was blinded by the headlights of an oncoming car and barely escaped going into a fence. "I shouldn't crab," he commented, "my lights may be even worse." [68]

Temporary Indispositions

Even those of us with the best of knowledge and intentions are not always in a proper physical or mental state to drive safely, for our driving may be adversely affected by transitory conditions. Both numerous and complicated, these include intoxication, fatigue, inattention, irritation, feelings of inferiority, nervousness, emotional shock, and ill health.

Intoxication. One of the most important temporary factors which contribute to accidents is alcoholic intoxication. [31] New investigations on the part played by drunkenness in highway accident causation increasingly indicate that from one-tenth to one-half (according to the locality concerned) of the persons involved in fatal accidents have been drinking alcoholic beverages.

One of the most careful studies on the effect of drinking on motor vehicle accidents was made in Evanston, Illinois. [125] In this study alcohol tests were made of the breath of 1,750 drivers chosen at random, and the results compared with the results of alcohol tests made of the urine of 270 drivers brought to Evanston hospitals after being involved in personal injury accidents. Twelve per cent of the unselected group of drivers showed alcohol in the blood, whereas 47 per cent of the drivers who had been involved in accidents were shown to have been drinking. The data showed also that there were thirty-three times as many drivers whose blood contained 0.15 per cent of alcohol or more in a group of

accident drivers as in a control group of drivers. (The National Safety Council's Committee on Tests for Intoxication recommends that any driver with more than a 0.15 concentration of alcohol should be considered as being definitely under the influence of alcohol.) [204]

The relative effect of different amounts of alcohol in the blood upon the liability to accidents is shown in Figure 24.

The Evanston report also revealed interesting information on the drinking habits of drivers during different hours of the day. The data

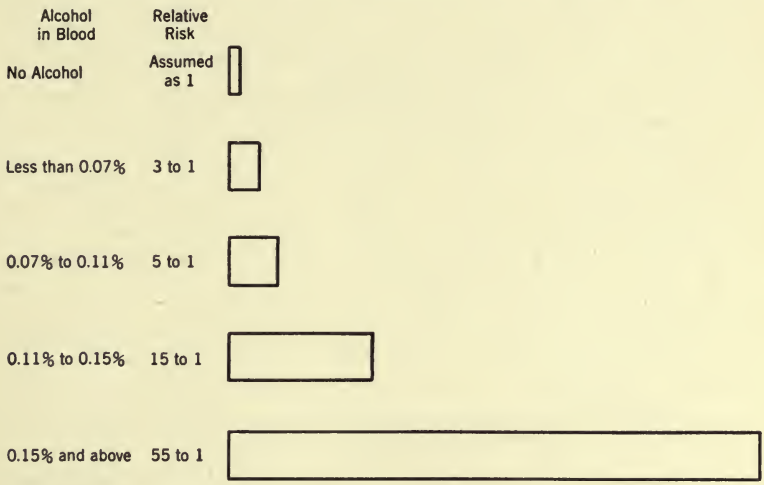


Fig. 24. Effect of varying amounts of alcohol in the blood on driver's chance of having a personal injury accident (Evanston, Ill., 1938).

Source: *Chemical Tests for Intoxication*, p. 7. Committee on Tests for Intoxication, Report to Street and Highway Traffic Section, National Safety Council, National Safety Council, 1938, Chicago, Ill.

showed that at 3 A.M. half of the drivers on the highway had been drinking to some extent, and that at 5 A.M. almost every driver involved in a personal injury accident had been drinking. As is demonstrated by Figure 25, drunken driving is primarily a night problem.

The majority of intoxicated driver accidents occur at night, reaching a peak on Saturday night. Speed is a contributing factor in about half of these accidents which involve principally drivers between 20 and 29 years of age. Few truck drivers and women are found among the drunken drivers. [213]

Our efforts at controlling the intoxicated driver have not secured better results for a number of reasons. One is that we make little systematic effort to prevent intoxicated persons from getting into vehicles in the first place. Another is that a large number of persons who drive while under

the influence of intoxicating liquors are reasonable-minded and respectable citizens, fairly skillful as drivers, who see no reason for not drinking before driving, and who if apprehended make use of influence to have the charges quashed. A third reason is that we do not yet have a sufficient array of facts and figures to prove convincingly how unsafe it is to drive after a moderate drink.

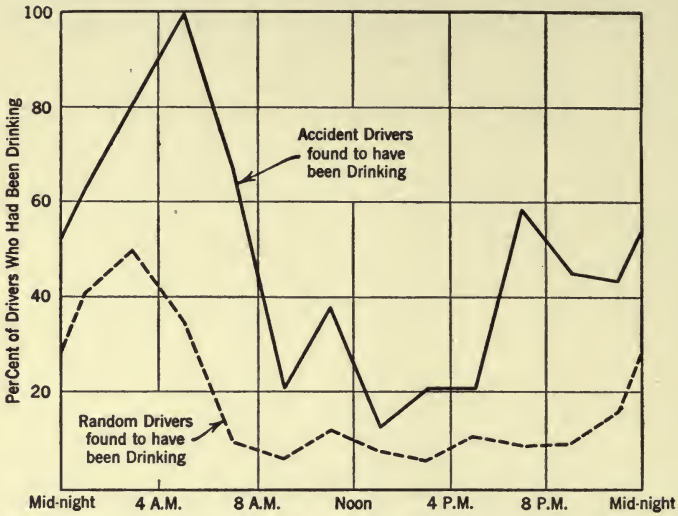


FIG. 25. Proportion of drivers found to have been drinking, by hours of the day (Evanston, Ill., 1938).

Source: Richard L. Holcomb, "Alcohol in Relation to Traffic Accidents," *J. Amer. Med. Assoc.*, 3, 1076–1085 (1938).

As regards the first point, much could be done if the cooperation of employees of parking lots, night clubs, taverns and such, together with that of sober companions, could be enlisted to aid in preventing intoxicated persons from entering and driving away motor vehicles.*

Since many responsible citizens believe they are the best judge of how much they can drink without ill effects, police officials and courts hesitate to define the number of drinks, or the amount of alcohol in the blood, sufficient to render a person too much "under the influence" to drive a car. More detailed information about the effects of different quantities of alcohol on behavior is needed by our police and courts to justify them in arresting and punishing persons who drive after drinking. Both the

* Massachusetts police carry out periodic check-ups of drivers leaving roadhouses where alcoholic liquors are sold, for the purpose of apprehending those who enter cars in an intoxicated condition.

public as well as enforcement agencies need scientific information on the subject. The public is tired in particular of precepts about the dangers of driving after even a small drink, because it is not convinced that this is a dangerous habit. If it could be proved that driving after any drink at all measurably lowers skill, then the task of educating the public to refrain from driving after drinking and of securing evidence to punish offenders would be made immeasurably easier.

Fatigue. The nature of fatigue is not clear to those who have studied it [260] but whatever else it may be, fatigue is certainly a forerunner of accidents. [207]

The most comprehensive study of driver fatigue is that which was carried out by the U. S. Public Health Service at the request of the Interstate Commerce Commission. [230] In all, 889 truck drivers were examined. A complete occupational history was obtained from each man, as well as an accurate account of his activities during the previous twenty-four hours and the preceding week. Physiological and psychological tests, including some laboratory driving tests, were given at the end of drives of various lengths. Men who had slept since their last drive were also tested.

The report of findings does not state what number of hours constitutes a safe daily driving period for the average driver. Nor does it indicate whether the decline in efficiency with continued driving as measured by different tests makes the drivers measurably more accident-prone. The decline in efficiency which seems to be gradual, varies considerably among different drivers.

The results of the various physiological tests such as blood pressure, heart rate and blood chemistry were found to be less closely related to hours driven than were the results of performance tests of the ability to accomplish a given task. The men who had not driven at all had the highest average efficiency on the various reaction and coordination tests, those who had driven less than ten hours had the next highest average efficiency, and those who had driven over ten hours had the lowest average efficiency.

Private as well as professional drivers must guard against fatigue, especially those who drive long stretches alone at night after a hard day's work. Many a fatal accident occurring to an unaccompanied driver has been correctly ascribed to his falling asleep at the wheel. Every driver should realize that the effects of fatigue are often so gradual as not to be noticed immediately, and that a person who felt perfectly up to standard at the start of the trip may suddenly and unexpectedly be overcome. Even the most safety-minded of drivers may in perfectly good faith overtax his resistance until fatigue and ensuing inattention lead him to disaster. Commuters whose homes are a long distance from their places of work

are especially vulnerable to this kind of accident. So are those who mistakenly think that they are accomplishing something commendable in making long trips without stopping at night for proper rest. These drivers are merely being "penny-wise and pound-foolish"; their lowered efficiency and slowed down reactions may land them in a hospital instead of at their destination.

Inattention. Inattention is no doubt one of the fundamental causes of many automobile accidents, for driving an automobile demands the utmost in the way of alertness. Chauffeurs, taxicab drivers, and bus and truck operators are probably the most attentive drivers on the road for the simple reason that their livelihood depends upon their keeping out of trouble. In contrast, some other drivers, although they are educated, intelligent, and socially responsible individuals, are inattentive while driving because their minds are focused on other affairs. College professors and executives, for example, may drive in a dangerous manner because they take their minds off the road in front of them while trying to solve mental problems.

An actual classification of the faults of motorists involved in accidents in one state reveals the following reported forms of inattention. [243]

Attempting to avoid bees or other insects.
Eating while operating.
Flirting with pedestrians on sidewalk.
Lighting cigarettes.
One-arm driving.
Playing with children or dogs in car.
Preoccupation or "daydreaming."
Reaching for hat that has blown off.
Reading billboards and newspapers.
Sleepiness.
Talking with occupants.
Tuning in or listening to radio.
Watching construction, fires, scenery, etc.

Irritation. Irritation induced by the inconsiderate acts of another driver such as his cutting in too sharply or "hogging" the middle of the road, or by the back-seat driving of occupants of his own car, often shatters a driver's composure. Some drivers react to such irritations by themselves engaging in reckless maneuvers designed to teach the offending drivers or passengers a lesson. Needless to say this lack of emotional control evidenced by anger and acts of revenge is particularly out of place in an occupation as potentially hazardous as automobile driving.

Feelings of Inferiority. Feelings of inferiority may carry over to one's driving behavior on the road. Persons with feelings of social in-

feriority, for example, sometimes derive considerable satisfaction from "showing off" by refusing to allow themselves to be passed, by weaving in and out to get ahead of a line of cars, or by speeding and indulging in other reckless acts. The frustration of "henpecked husbands" may similarly find an outlet in pugnacious behavior on the highway.

Nervousness. Many timid persons react in just the opposite way. They are inclined to cause accidents by their panicky attempts to avoid them. Worry about events that occur on the road, or that might occur, often unnerves them. A car passing a shade too closely, an unforeseen obstacle or a narrow escape may upset their mental balance. Such individuals are likely to become extremely agitated after an accident, especially if they have injured or killed a human being; and through fright they may join the ranks of the hit-and-run drivers.

Emotional Shock. Emotional shock also plays a role in accidents. Sudden unfortunate news like death in the family, loss of employment, or financial ruin (perhaps through the stock market) may absorb the attention of the motorist to such a degree that he has difficulty in keeping his mind on his driving. Such a blow may induce a sort of mental blindness that makes it difficult for the driver to perceive hazards while driving. This confusion and bewilderment after sudden emotional shock is frequently at the bottom of accidents. "He did not know what he was doing or where he was going" applies to many a driver who has been involved in a collision after a sudden stroke of personal misfortune.

Ill Health. Ill health is another factor causing potentially good drivers to be involved in accidents. Anemia, tuberculosis, or serious chronic diseases may gradually lower the resistance and enfeeble the reactions of a driver in a way of which he is not aware. Still more difficult to guard against is sudden illness, such as an unexpected fainting spell or heart attack. Those who know they are susceptible to such seizures should realize that the driver's seat is too dangerous a place for them, and in justice to other users of the road should refrain from driving. It has been suggested that when a driver subject to seizures has been overcome at the wheel and has caused an accident resulting in injury to others, physicians should be compelled to report such a patient to the motor vehicle department, if they know he or she continues to drive.

Drivers must realize that driving is to be classed as a dangerous occupation requiring the maximum of attentiveness and physical fitness. If operators are not at their best, either because they have been drinking, or are tired, or feeling ill, they should avoid driving; or if in exceptional circumstances they feel they are obliged to take the wheel, they should do so with full realization of their handicap and try to drive more slowly and carefully than usual.

Safe driving requires insight and self-control. The only consistently safe drivers are those who are aware of their failings as drivers and who systematically strive to overcome them.

TESTING SAFETY-MINDEDNESS

A number of authors have emphasized the importance of personality traits, emotions, and attitudes in automobile driving [26, 35, 36, 247, 258, 268, 272, 290], and attempts have been made to devise tests to measure such factors as recklessness and carelessness [44, 287], but so far no satisfactory test has been devised to measure the safety-mindedness of automobile drivers,

Previous discussion has indicated that intelligence is probably a factor of some importance in safety-mindedness. However, although there is common agreement that a certain amount of intelligence is necessary to drive an automobile safely, estimates vary widely as to the level required. [109, 150, 184]

The most serious drawback to paper and pencil tests of safety-mindedness is that intelligent persons are usually able to figure out the correct answers called for in the tests, regardless of whether they actually maintain the proper attitude when they are behind the wheels of their cars.

Undoubtedly the best place to observe a driver's safety-mindedness is when he is actually traveling down the road. Thus we should expect a road test, such as the license examination road test, to give us some idea of this quality. Unfortunately, the presence in the car of a second person who is known to be on the lookout for improper attitudes, places the driver on his good behavior and makes it difficult to obtain a true estimate of his normal driving.

The State License Examination Law Tests

Law tests given as part of the license examination are also used as a means of testing safety-mindedness. Most states in an effort to promote the development of safety-mindedness among new applicants for the license now issue a driver's manual which contains valuable hints on safe driving practices, in addition to a summary in non-technical language of the important motor vehicle laws (see Chapter XIII).* The so-called law test, required as a prerequisite for the license in all but 12 states [6, *14*], aims at measuring the applicant's knowledge of his driver manual.

* For truck drivers, an excellent handbook is that issued by the Atlantic Refining Company, Philadelphia, Pa. [20]

Four forms of these law tests are in use. The most popular type is the *multiple-choice* test in which the applicant checks the one correct statement out of a group. For example:

When is it permissible to double-park your car? (Check one)

a. To run into a store just for a minute.
b. If there are other cars double-parked in the street.
c. On one-way streets during hours of light traffic.
d. It is never permissible.*
e. For brief errands in post offices or other government buildings.

The chief advantages of the multiple-choice test are that it can be administered and scored more uniformly than other types of tests. It eliminates any personal bias on the part of the examiner and permits answering and scoring the test in a short time. Furthermore, it does not handicap the person with limited educational advantages by requiring him to phrase his answers in good English.

A second type of this kind of test is the true-false variety. Having only two rather than four or five choices to make, the person taking this test has a better chance to guess right than in the case of the multiple-choice test. One of the most carefully worked out true-false knowledge tests for adult automobile drivers is that by Abercrombie. [1]

A third method of giving the law test is by a long *written examination* in which the applicant is asked to write out his answers. This method is practicable among applicants who can write and express themselves easily, but it puts a premium on language ability and seriously handicaps the individual who has not had the advantage of much schooling.

A fourth type of examination is *oral.* According to the American Association of Motor Vehicle Administrators:

The ideal oral test is one in which a well-trained examiner has adequate time to become personally acquainted with the applicant and discuss with him the reasons for the various laws. It gives the examiner an opportunity to frame questions in such a manner as to elicit information about the applicant which might otherwise remain hidden. The oral test is also useful in furnishing an indication of the relative education and intelligence of the applicant. In cases of individuals who cannot read or write it is the only kind of test which can be used.

But in view of the motor vehicle department's limitations of staff, time and money, and the fact that the law test must not monopolize too much of the time available for the entire examination, an adequate oral test is scarcely practicable for all applicants in most departments at the present time. When examiners are crowded for time they usually shorten the examination to two or three questions which the applicant is permitted to answer in a perfunctory

* This is the correct answer.

manner. If the oral test has to be given hastily it is not so effective as a short standard written test uniformly administered. [6, *22*]

In consideration of the disadvantages of a long oral or written test, the motor vehicle administrators recommend as more practicable the multiple-choice examination, which can be easily and quickly answered by persons with a minimum education.

Modern driving, like golf, tennis, or basketball, requires not only skill but also a knowledge of the rules of the game. State law tests serve a very useful purpose as a part of a general qualifying examination to indicate whether the person tested knows how to drive safely if he is willing to *try*, but they admittedly do not tell us whether he *will* try.

As has been mentioned previously a most promising technique of measuring safety-mindedness is by utilizing the motion picture to present accident-provoking traffic situations. Study of driving behavior under stress offers such encouraging possibilities in studying safety-mindedness that we can scarcely afford to ignore it in this connection any longer.

But until we can perfect more suitable tests of safety-mindedness the best means of trying to predict whether a skillful operator will drive safely * is to combine his score on a good law test with information about his character and adjustment to society. Thus a driver whose past life (as indicated by his schooling, ability to make a living, obedience to laws, and adjustment to family and friends) demonstrates that he has social responsibility, normally makes a better risk than a person who lacks these characteristics.

SELECTIVE SAFETY EDUCATION NEEDED

An attempt has been made in this chapter to show that the influences of society which tend to make good citizens also help to mould drivers who keep out of accidents. There are, to be sure, exceptions, as was pointed out in the previous section, when even the most stable citizen may become involved in an accident, but in general there is a relationship between avoidance of accidents and such factors as healthful living conditions, reasonable economic security, adequate education, and a happy and orderly home life. All these factors help one to develop a well-integrated personality with normal consideration for one's fellow citizens.

Recent studies have revealed a tendency of children's intelligence quotients to rise in relation to improved environment and to fall with cultural deterioration. Safety-mindedness seems to be influenced by similar

* Where time and circumstances permit, the driver in question may be trailed, and his behavior observed when he is not aware that he is being watched.

environmental conditions, i.e., it is high among drivers enjoying the advantages of a favorable environment and is low among drivers handicapped by a poor environment. However, besides trying to provide better opportunities for the development of a well-adjusted citizenry, if it expects to reduce the number of less safety-minded drivers, society must find out who they are, where they live, and then take special steps to improve their knowledge and modify their attitudes.

For those whose social status has hampered them in acquiring "safety-mindedness," a special approach is necessary. The high-ratio accident areas in which they live must be determined, and adequate means taken to reach them. At present these persons are seldom in contact with safety education through its usual channels of newspaper, pamphlets, lecture, and radio. Some special means of simple, clear, and easily available instruction is needed for them, presented when necessary in both English and foreign languages.*

Safety education in endeavoring to inculcate safety-mindedness and to enforce discipline must take into account the different needs, different interests, and different problems of different groups. Up to now, safety education has been inclined to be too general.

The groups needing to be reached must be selected more carefully and methods of approach must be better adapted to their individual requirements. Before a safety education plan is formulated the following factors should be taken into consideration.

1. What occupational groups are concerned?
2. From what types of homes do the members come?
3. What is the degree of literacy of the group?
4. What is the economic status of the group?
5. What is the age level?
6. Are the drivers urban or rural?
7. What types of accidents are most common in the group?
8. What are the most suitable means available for the dissemination of knowledge and information?

In brief, selective safety education must be directed toward the requirements of those who need it most and be suited to their characteristics.

* The American Automobile Association, for example, to reach non-English speaking pedestrians, has published in a number of foreign languages a set of rules for safe walking.

DEVELOPMENT OF INDIVIDUAL RESPONSIBILITY FOR NATIONAL, STATE, AND COMMUNITY SAFETY

In addition to developing in the individual an appreciation of his responsibilities while using the highways, we must attempt to inculcate in him a realization of the important relation between the elimination of highway accidents and the national welfare of his community, state, and nation. We need to try to show him that the needless waste of our human and material resources from accidents should not be tolerated any more than the threat to our national welfare from the activities of Hitler and his armed forces. To defeat the Axis we have mustered together all our resources and energies with a singleness of purpose and a determination to win which is bound to secure success. If we could attack the accident problem with the same united zeal we could soon prove that we can get the better of it.

Before we can secure the wholehearted backing of the American people to support public authorities in an all-out attack on highway accidents, however, we need to do the following: prove to them beyond a shadow of a doubt that most accidents can be prevented; show them how; give them figures on how much it will cost; and, what is most important, indicate clearly what they will have to give up in the way of personal freedom, and why.

We have the brains and we have the money to provide this information, and we have the best-coordinated communication system in the world to transmit it to our people. Why then haven't we done these things? Because both the public and its accredited officials have not yet appreciated the fact that efficient management of drivers in our democracy must of necessity involve research on such problems as are mentioned above and a wide dissemination of the findings. We can develop safety-mindedness in our citizens if we are willing to try. So far we have made little progress because we have not been willing to try very hard.

THE INTERACTION OF EXPOSURE, SPEED, SKILL, AND SAFETY-MINDEDNESS

In Chapters II, III, IV, and V it has been shown that the human causes of accidents are multiple and that any thorough-going estimate of the accident susceptibility of a driver must take into consideration his exposure, speed, skill, and safety-mindedness.

Thus some drivers may keep out of accidents because of low exposure, others because of consistent slow-speed driving, others because of excep-

tional skill, and a fourth group because of a highly developed sense of safety-mindedness, which because it is, generally speaking, of major importance influences how much, and where, and when, and how fast they drive. The fine records of most accident-free motorists are due naturally to the interplay of two or three or perhaps all these factors.

Drivers in accidents, when not blaming them on the other driver, are inclined to attribute their accidents primarily to the first of these factors—exposure, which is an external condition, and to ignore their own willful shortcomings as represented by the other three factors we have discussed. This is only human nature.

A proper understanding of all the factors contributing to the accident, as well as those conditions immediately connected with it, is desirable both in punishing and in curing drivers. Thus highway patrolmen, traffic judges, and motor vehicle department hearing officers could mete out punishments more fairly to the drivers they have to deal with, and public administrators, writers of safety propaganda, and teachers would be able to carry out their preventive work more effectively if they knew more about the factors of exposure, driving speed, skill, and safety-mindedness which play such important parts in the causation of accidents.

CHAPTER VI

GATHERING HIGHWAY ACCIDENT INFORMATION

This chapter and the next two chapters will deal with the general subject of gathering and correlating information on automobile accidents. The present chapter emphasizes the need for more complete reporting of such accidents, stresses the limitations of our present state and national accident-reporting systems, and offers suggestions for a more effective analysis and use of accident information. In Chapter VII various methods of measuring the highway safety status of different states will be discussed and criticized. Chapter VIII will be concerned with the important but neglected geographical, economic, climatic and sociological factors which influence the highway safety status of different states and regions.

PRESENT STATUS OF THE COLLECTION OF HIGHWAY ACCIDENT INFORMATION

Few large commercial organizations would stay in business long if they did not make a practice of assembling basic information to guide them in managing their affairs. Fact gathering, cost accounting, and research are coming to be accepted as indispensable to the proper administration of any successful business concern.

But what do those in the highway accident prevention business know about automobile accidents occurring in this country? How much do we really know about the actual number of automobile accidents and the cost of these accidents in dollars and cents throughout the United States?

Upon investigation we find that basic accident information for the United States as a whole as well as for the separate states is sadly lacking. The only figure on national accidents which is at all dependable is the *number of persons killed.* Figures so frequently encountered in print on the number of persons injured, and the number and cost of property damage accidents, are merely rough estimates based upon the experience of a few states and cities assumed to be doing an efficient job of gathering records of accidents.

In order to gain a true picture of the present highway accident situation so that we may plan an effective program for the future and get the great-

est return in accident reduction for the funds expended, decided improvements must be made in the reporting of accidents and the assemblage and presentation of accident data. Particularly needed is more complete reporting of personal injury and serious property damage accidents.

Agencies for Accident Information Collection

The *Bureau of Motor Carriers of the Interstate Commerce Commission* is the only federal agency that collects motor vehicle accident information from individual private operators. One of the principal functions of the Bureau, which has jurisdiction over the operators of interstate trucks and buses, is the collection and analysis of accident reports submitted by them.

The *Bureau of the Census* in the Department of Commerce issues periodic summaries of motor vehicle fatalities. These summaries are compiled from the reports submitted by the *vital statistics departments* of every state.

Federal collection and analysis of motor vehicle accident data is therefore very limited in scope; there is room for a considerable extension of federal activity in this connection. Meanwhile for accident information we must rely on the *state agencies* that collect accident reports.

Highway accident data are obtainable in the majority of states from one of two agencies. The more important of these is the motor vehicle department; or in certain states the state highway or the state police departments. The state department of vital statisics also furnishes data on *fatalities* of all sorts, including those which occur on the highways.

Differences between Collection Methods of Vital Statistics Departments and Motor Vehicle Departments

Traffic fatalities are naturally a chief concern of motor vehicle departments. Most motor vehicle departments compile statistics on highway deaths, which can be supplemented where necessary by information collected by vital statistics departments. Consequently, we are able to obtain comparatively reliable figures on motor vehicle fatalities from almost every state.

The figures on persons killed, as furnished by the two types of agencies mentioned above, do not correspond exactly. This is due to a fundamental difference in the purposes of the two departments in assembling such figures. Motor vehicle departments are interested in accident statistics, primarily because as departments they are ordinarily vested with the responsibility of preventing future accidents. Vital statistics depart-

ments, on the other hand, are ordinarily little concerned with highway accident prevention. Because of this variation in point of view several differences in reporting requirements exist between motor vehicle departments and vital statistics departments.

Motor vehicle departments record only those fatalities occurring on public streets and highways, whereas vital statistics departments also record fatalities involving motor vehicles which occur on private property. Thus the vital statistics figures for 41 states in 1937 were 3 per cent higher than the motor vehicle department figures primarily because the latter excluded non-traffic deaths.

Motor vehicle departments classify deaths by *time of accident,* since it is the circumstances surrounding a particular accident at a particular time that concern a motor vehicle department. Vital statisticians classify by *time of death*—which leads to disagreements in the two records when deaths are delayed. Further, motor vehicle statistics always charge deaths to the *place of accident,* whereas up to recently vital statistics practice has been to charge deaths to the *place of occurrence.* All these factors make for discrepancies between the figures issued by the two agencies. It is customary to describe motor vehicle deaths as *total motor vehicle deaths* when they are compiled on a vital statistics basis; those compiled on a traffic statistics basis are called *motor vehicle traffic deaths.*

The Bureau of the Census in January, 1941, put into operation a new plan of coordination between the state vital statistics and traffic authorities whereby it now compiles figures on both place of death and place of accident.

Determining the Number of Fatal Accidents and Drivers Involved from the Number of Reported Fatalities

A few state motor vehicle agencies do not collect accident reports even for fatal accidents. In these states, therefore, fatalities are counted only by the vital statistics departments. Such information covers only persons killed; no figures are presented as to the *number of fatal accidents* or the *number of drivers involved* in the deaths reported. Consequently, accurate national figures on the number of fatal accidents and drivers involved are not available.

Table 29 shows some typical ratios of persons killed per fatal accident and drivers involved per fatal accident in states where these figures are available. The number of persons killed is always larger than the number of fatal accidents, and the number of drivers involved is, of course, even larger. In general, highly urbanized states like Massachusetts, Connecticut, New York, Rhode Island, Pennsylvania, and New Jersey have

fewer persons killed per fatal accident than the more sparsely populated states. The larger proportion of pedestrian-type accidents around cities helps to explain the fewer persons killed per fatal accident in highly urbanized states.

TABLE 29

THE NUMBER OF PERSONS KILLED AND THE NUMBER OF DRIVERS INVOLVED PER HUNDRED FATAL ACCIDENTS

(Twenty-five states, 1940)

State	Persons Killed per 100 Fatal Accidents	Drivers Involved per 100 Fatal Accidents
Massachusetts	105	115
Connecticut	106	121
New York	107	121
Rhode Island	108	105
Pennsylvania	108	125
New Jersey	108	131
Oregon	109	128
Arizona	110	126
Utah	110	124
Tennessee	111	119
Washington	111	133
Arkansas	112	125
Iowa	112	137
North Dakota	113	124
Georgia	114	123
Minnesota	114	126
Virginia	115	127
South Carolina	116	126
Alabama	116	131
Nebraska	117	129
Indiana	118	136
Texas	118	136
Louisiana	118	142
Oklahoma	119	130
Idaho	123	129
Average for 25 states	112	127

Source: Developed from the annual accident summaries of the states.

Fatal accidents, as we see, often involve the death of more than one person. The number of persons killed per accident varies greatly with different types of accidents. The figures in Table 30, which follows, are averages from 22 states.

In the order of their deadliness in a single accident come automobile-train smashups, automobile-street car collisions, automobile-automobile crashes, automobile-fixed object collisions, non-collision crackups, animal accidents, and finally bicycle and pedestrian accidents.

TABLE 30

NUMBER OF PERSONS KILLED PER HUNDRED FATAL ACCIDENTS CLASSIFIED BY TYPE OF ACCIDENT
(Twenty-two states, 1940)

Type of Accident	Persons Killed per 100 Fatal Accidents
Collision of motor vehicle with	
Train	145
Street car	130
Motor vehicle	130
Non-collision	116
Fixed object	116
Animal	116
Miscellaneous	108
Bicycle	103
Pedestrian	101
Animal-drawn vehicle	43
Average for all types of accidents	113

Source: Developed from the annual accident reports of the following states: Ala., Ariz., Ark., Conn., Ga., Ida., Ind., Ia., La., Minn., Neb., N. J., N. D., Okla., Pa., Tenn., S. C., R. I., Tex., Utah, Va., Wash.

REPORTING OF PERSONAL INJURY ACCIDENTS

Reporting of persons injured in accidents does not approach the reporting of fatalities in completeness. Although every state that requires a report of fatal accidents also requires a report of accidents in which someone is injured, many operators do not report personal injuries. One indication of the efficiency of accident reporting in a state is a high ratio of reported persons injured to persons killed. Another indication is the number of persons reported injured per 100,000,000 vehicle-miles of travel. The table below shows these ratios for a number of states.

Note that, in general, high ratios of persons injured to persons killed are recorded by states in the northeastern part of the country where accident-reporting systems have been in operation for many years. Low ratios, on the other hand, are for the most part reported by states that have started only recently to collect accident statistics. These differences in ratios result in part from variations in the effectiveness of states in securing reports of personal injury accidents. But it would be erroneous to assume that all states must have a high ratio of persons injured per fatality in order to demonstrate that their reporting systems are functioning efficiently in the collection of personal injury accident reports.* This

* This point of view is expressed by one writer, who states: "A check can be made of the completeness of reporting because it is known that generally 35 per-

TABLE 31

NUMBER OF PERSONS INJURED PER FATALITY AND PER 100,000,000 VEHICLE-MILES OF TRAVEL

(Twenty-four states and the District of Columbia, 1938)

States	Persons Injured per Fatality	Persons Injured per 100,000,000 Vehicle-Miles
Idaho	4.7	75
Nevada	5.6	84
Maine	5.7	57
South Dakota	6.2	63
West Virginia	6.8	106
South Carolina	6.8	131
North Carolina	8.1	151
Texas	9.0	103
Louisiana	10.1	91
Virginia	10.7	167
Illinois	11.3	150
Wisconsin	12.0	128
Arizona	12.9	222
Minnesota	14.5	85
Utah	15.5	303
Michigan	15.7	189
Washington	16.8	197
Colorado	17.0	222
California	18.4	249
Oregon	20.0	249
Iowa	20.1	167
Nebraska	20.7	176
Pennsylvania	26.8	289
New Jersey	28.8	243
Connecticut	32.8	271
New York	38.1	427
New Hampshire	42.4	322
District of Columbia	43.2	208
Rhode Island	44.2	213
Massachusetts	76.7	555

Source: Figures for injuries and fatalities developed from figures in the annual statistical summaries of these states for 1938. Vehicle-mile figures from U. S. Public Roads Administration table, G-21, 1938, "Analysis of Motor-Fuel Usage in Calendar Year 1938."

unwarranted assumption has plagued motor vehicle department statisticians in many a rural state. The truth of the matter is that the number of personal injuries per fatality or per vehicle-mile varies considerably with the degree of urbanization of a state. A highly urbanized state such

sonal injury accidents and 150 property damage accidents occur for each fatal accident." [219, *35*]

as Massachusetts or Rhode Island will have a higher than average ratio of personal injury accidents to fatalities for the reason that most of the driving is urban driving. In urban regions personal injury accidents greatly exceed fatal accidents in number owing primarily to the slower speeds at which cars are driven in congested urban areas. (See Chapter II, p. 18.)

The fact that rural areas have considerably fewer personal injuries for each person killed than do urban regions can be demonstrated by a consideration of figures derived from a report issued by the New York Bureau of Motor Vehicles. Notice in the table below how the ratio of injuries to fatalities declines progressively from large cities to small cities to rural areas. Although reporting of personal injury accidents is probably somewhat less complete in rural areas than in urban areas, this factor alone can scarcely account for the wide differences noted in the table.

TABLE 32

RATIO OF MOTOR VEHICLE DEATHS TO MOTOR VEHICLE INJURIES BY POPULATION GROUPS OF RESIDENCE

(New York, 1939)

Population Group	Deaths	Injuries	Injuries per Death
New York City	841	52,200	62+
Cities over 10,000	355	17,933	50+
Villages and cities over 10,000	422	10,240	24+
Rural areas	811	15,573	19+

Source: Adapted from figures in *Annual Report of the Bureau of Motor Vehicles, State of New York, 1939,* Appendix. Department of Taxation and Finance, 1940, Albany, N. Y.

A breakdown of accident reports in one state for the last half of 1939 shows that urban residents had 14.5 injury accidents to one fatal accident, whereas rural residents had only 9 injury accidents to one fatal.* Still another confirmation of the fact that drivers who live in densely populated regions have more injury accidents, are the accident figures from another state showing that city operators have 7.6 injury accidents for each fatal; small town drivers, 3.8; and rural dwellers, 2.5.†

Since variations in density of population and other factors make it impossible to calculate accurately the number of personal injury accidents or property damage accidents from the number of reported fatal accidents,

* Statistical summary of motor vehicle accidents, Nebraska, July–December, 1939.

† Statistical summary of motor vehicle accidents, Texas, 1939.

it is necessary in order to obtain a true picture of the accident situation as a whole to obtain reporting of all personal injury accidents and the more serious property damage accidents.

Reporting of Property Damage Accidents

Since there is usually very little damage to a vehicle when it hits a pedestrian, in a state like Connecticut whose automobile fatalities are preponderantly pedestrian, the majority of fatal accidents do not involve property damage. Other types of motor vehicle fatalities, however, usually involve some property damage. In states where non-pedestrian fatalities predominate, property damage occurs with greater frequency in fatal accidents.

TABLE 33

Proportion of Accidents in Which Property Damage of $25 or Over Was Reported, Classified by Type of Accident

(Connecticut, 1939)

Type of Accident	Accidents	Accidents Involving Property Damage of $25 or Over	Percentage of Accidents Involving Property Damage of $25 or Over
Fatal	332	112	33.7
Personal injury	8,602	5,377	62.5
Property damage	9,591	9,591	100.0 [1]

1 Connecticut does not require the reporting of accidents involving only property damage of less than $25.

Source: Adapted from figures in *Traffic Topics, Statistical Summary, 1938–1939.* Department of Motor Vehicles, Hartford, Connecticut.

About two out of every three personal injury accidents in Connecticut involve property damage to the extent of $25 or more. Of all reported accidents in Connecticut approximately one-half involve only property damage.

Connecticut accident figures are probably typical of good reporting in a densely populated, urbanized state. The reporting of property damage accidents, however, is done very poorly in most parts of the United States. A primary reason is that there is a universal tendency among operators to avoid reporting non-injury accidents. Reporting, even in states with efficient reporting systems, is ordinarily confined to those accidents which are serious enough to come to the attention of the authorities.

The second reason for our lack of information about property damage accidents is the fact that many states do not attempt to secure reports on accidents of this type. Among those states which do require reporting of property damage accidents there is great variation with regard to the minimum amount of damage which is legally reportable. This minimum amount ranges from $100 in one state down to the requirement of several states that damage of any amount must be reported. The most common minimum damage reportable is $50.

The number of property damage accidents and the monetary loss from them can, therefore, be only roughly estimated. The National Safety Council estimates that there are 150 property damage accidents for each person killed. However, as we have previously pointed out, this ratio undoubtedly varies considerably from state to state depending upon the laws regulating accident reporting, the density of population, and a number of other factors.

Variations in State Reporting Systems *

Twenty-five states have complete central control over accident reporting. By central control is meant a system wherein all operators who are involved in accidents must report directly to a central state agency. Sixteen states have partial central control, whereas 7 states have no central control.

Five states do no require operators to report any accidents. Of those that do require reports, the kinds of accidents which must be reported vary widely. Eight states call for reports of fatalities and personal injuries only. Thirty-four states require operators to report accidents involving death, personal injury, or property damage. The great majority of these states set minimum levels of property damage and stipulate that all accidents causing damage less than the amount stated need not be reported.

IMPROVEMENT IN ACCIDENT REPORTING

Our knowledge of accidents being so incomplete and our system of reporting so ineffective, it behooves us to make accident reporting compulsory, and to see that sufficient funds be set aside to provide for an efficient accident research section in every state.

* The figures used in this section were taken from the latest available survey of state accident-reporting systems, which was made by the Statistical Bureau of the National Safety Council, July, 1940. [208] See also the survey made by P. J. Stupka early in 1937 for the Bureau of Public Roads as a part of the Bureau's extensive study of motor vehicle traffic conditions in the United States. [234]

The Need for Better Reporting of All Accidents

Adequate reporting of accidents is vital to a properly integrated accident prevention program. In general the more complete the reporting the more useful is the information.

The extent of injury or damage is no index of the significance of an accident. Excluding minor accidents by basing an accident-reporting system on the amount of property damage in terms of dollars tends to discourage the reporting of all but the most costly accidents. Ideally, all accidents should be reported where there is damage or injury, regardless of the extent of injury or the amount of property damage. From a practical standpoint it is at present impossible to secure complete reporting, but efforts should be made to secure the most thorough reporting of accidents as is possible under the circumstances.

Effective engineering improvement of dangerous locations depends largely on prompt and accurate reporting of all accidents regardless of the seriousness of the injury or the cost of the property damage. An intersection at which several less severe unreported accidents have happened may be as potentially dangerous as one at which a reportable fatality has occurred. Accurate identification of such road hazards cannot be made if the more severe accidents only come to the attention of the authorities. Fatal accidents, particularly, occur relatively infrequently (they amount to only 1 or 2 per cent of the total accidents in states with good reporting), and are of limited use in the discovery of highway hazards.

The efficient disposition of traffic patrolmen at the places and during the times that accidents occur most frequently, clearly depends upon complete reporting of accidents. Without this essential knowledge about the occurrence of accidents it is impossible for a traffic police force to carry on its work with maximum effectiveness.

Comprehensive accident reporting is even more important as a basis for control of erring drivers. Only a very few accident repeaters, if any, can be discovered when only fatal accidents are reported, for, although the total number of fatal accidents is small, the number of drivers involved in two or more fatal accidents is still smaller. To discover the majority of accident repeaters, compulsory reporting of non-fatal accidents is needed.

More complete accident reporting would also be helpful in enabling us to gain a more accurate picture of the comparative safety status of the different states. The comparisons of safety status of the states made in Chapter VII and VIII depend on the number of fatalities only, which rep-

resent but a small share of all accidents. If non-fatal accident rates could likewise be compared, the relative standing of the states might change considerably. Since sparsely populated states have fewer personal injuries per fatality than densely populated states, a comparison of states on the basis of fatal *and non-fatal* accidents would probably lower the ranking of densely populated states and raise the standing of sparsely populated ones. In other words, it seems likely that our dependence on fatalities for a comparison of safety status gives the densely populated, urbanized states a higher ranking than they would obtain if we could compare the states on a total accident basis.

Types of Accidents Emphasized by Better Reporting

The question is sometimes asked: "As accident reporting becomes more complete what information is obtained that cannot be obtained from partial reporting?" A completely satisfactory answer to this question is impossible at the present time because of the dearth of data on the subject.

This can be said, however, that since fatal accidents are reported most adequately, personal injury accidents next, and property damage accidents least, as reporting becomes more complete the proportion of personal injury and property damage accidents reported naturally becomes larger.

To determine what types of accidents we should expect to appear more frequently with wider reporting, let us examine Table 34 which shows the proportions of different types of fatal, personal injury, and property damage accidents. In a state which at present is collecting reports on only a small percentage of the total accidents which occur, the proportions probably resemble those in columns one and two. With wider reporting of accidents we should expect a considerable increase in the number of property damage accidents reported. When this happens, those types which are most common in column three will be reported with increasing frequency.

Accidents Whose Proportion Would Decrease with Wider Reporting. The more serious types of accidents, that is, those which are more likely to result in fatalities when they occur, will show a proportionate decrease with more complete reporting of personal injuries and property damage. These accidents, according to our table, would include pedestrian accidents, collisions with railroad trains, and non-collision accidents.

Pedestrians have less chance of surviving after being hit by an automobile than persons involved in other types of motor vehicle accidents. In addition, pedestrians are never involved in accidents which result in prop-

TABLE 34

PERCENTAGE OF FATAL, NON-FATAL AND PROPERTY DAMAGE ACCIDENTS CLASSIFIED BY TYPE OF ACCIDENT
(Twenty-one states, 1940)

Type of Accident	Fatal Accidents	Non-Fatal Accidents	Property Damage Accidents
Collision of motor vehicle with			
Pedestrian	36.7	25.0	....
Other motor vehicle	26.5	53.9	81.4
Train	3.8	0.7	0.5
Street car	0.2	0.8	0.9
Animal-drawn vehicle	1.3	0.5	0.3
Bicycle	2.4	0.4	0.2
Animal	0.2	0.4	1.2
Fixed object	7.3	7.0	6.4
Non-collision	21.0	10.9	8.8
Miscellaneous	0.6	0.4	0.3
	100.0	100.0	100.0

Source: Developed from the annual accident summaries of the following states: Ala., Ariz., Ark., Conn., Ga., Ida., Ind., Ia., La., Minn., Neb., N. J., N. D., Okla., Pa., Tenn., S. C., Tex., Utah, Va., Wash.

erty damage only. An increase in the number of property damage accidents would, therefore, result in fewer pedestrian accident reports as compared with reports of other types of accidents.

In the case of railroad-automobile accidents the occupants of the automobile are usually killed or seriously injured. Because few railroad-automobile accidents involve only property damage, more complete reporting would yield diminishing returns as regards this type of accident.

Most non-collision accidents are the result of high speed. Since fatalities or injuries usually accompany this type of accident, there would be relatively few additional non-collision accidents reported with more complete coverage of property damage accidents.

Accidents Whose Proportion Would Increase with Wider Reporting. The greatest increase in accidents reported with complete reporting would involve automobile-automobile collisions, since this type of accident comprises the majority of all property damage accidents. A common type of automobile-automobile accident which goes unreported is the rear-end collision. Unquestionably more complete reporting would yield large numbers of this type. Another common type of collision

which is seldom reported is the minor collision at intersections. A third common type of minor accident is fender scraping with another moving car. Reports on all these types of accidents would increase with more intensive coverage.

Under better reporting urban accidents would undoubtedly show a more marked increase than rural accidents, because of the high ratio of personal injury and property damage accidents to fatal accidents in urban areas. Congestion in cities resulting in the conflict of many vehicles and pedestrians and in slow speeds of travel naturally increases the ratio of minor accidents to serious ones.

Methods of Obtaining Adequate Reports on All Accidents

Two steps are necessary to obtain good accident reporting from the driving public: (1) to educate drivers to report accidents and (2) to discover those accidents which are not reported, with the purpose of punishing the drivers involved.

Educating the Public to Report Accidents. Because of the difficulty of obtaining a report from everyone who has an accident, no state has complete accident reporting. Merely passing a law requiring all drivers to report accidents will not insure their doing so. People neglect to report, not knowing that accident reports are required or not thinking the accident is important enough to report. Some drivers cannot remember the details of the accident, either because in their confusion and bewilderment they failed to notice just what was occurring, or because through shock or injury, they have suffered a loss of memory. And a certain proportion of drivers avoid writing in, or give an inadequate or false report, for fear of making an admission of responsibility which might be used against them later in court.

To encourage honest reporting most states protect the individual by making accident reports confidential. This allays the fears of those who might hesitate to report their accidents if the report forms were public and could be produced as testimony against them in court.*

In addition to keeping its files secret a state must take steps to educate its drivers to report accidents, and to teach them how to fill out the report forms adequately. One of the most effective ways of doing this is for

* However, in a state where the authority to take away licenses is strong, false reporting is extremely common, despite the confidential nature of the accident report. This tendency to minimize one's responsibility for the accident leads many authorities to believe that accident reports are of very doubtful utility in affixing the blame for accidents. Realization of the legal and financial consequences of accidents leads many persons to rationalize the real human causes of accidents and to blame them

the state to include details of the law requiring accident reporting and also instructions on how to report an accident, in the manual given to drivers applying for a license. A half dozen states now do this. One state is going farther and attempting to reach all previously examined drivers by including with renewal licenses instructions on how to report accidents.

Discovering Unreported Accidents. Besides educating its drivers to report their accidents a state must also take steps to induce them to cooperate in reporting accidents in which they are not involved. It must act not only as a collecting office but also as a detective agency to discover motorists who neglect to send in reports. Efficient state motor vehicle departments have devised a number of ways to catch up with persons who fail to report. They clip stories of automobile accidents from all newspapers published in the state. They obtain the cooperation of state, county, and city enforcement officers—police, sheriffs, justices of the peace, judges, and such officials—in securing accident reports. They encourage witnesses of accidents to report them. They license garages and require them to make a report on every car brought in for repair after a serious collision. They urge hospitals, physicians, and coroners to report all automobile accident cases handled. Because few states obtain the cooperation of all the above agencies (the cooperation of local enforcement agencies is particularly poor in most states) in bringing in reports, accident reporting in most states is incomplete. Only by following up on all these leads can state departments be sure of obtaining fairly complete records of accidents.

The punishment of those who knowingly fail to report accidents is another necessary feature of an efficient accident system. Since there are always a few recalcitrant individuals who take pride in flouting the law, it is necessary for a state now and then to remind the public that accident reporting is compulsory, by making examples of offenders. Failure to report a reportable accident should entail a certain penalty which should be invoked whenever merited.

Establishing a Uniform Report Form

The type of data most commonly collected by those states which have accident reporting is as follows:

on other factors, such as the car or the roadway. It is human nature to be blind to one's own shortcomings, and nowhere does this trait appear in a more exaggerated form than in the statements set down on many accident report forms. Other methods of checking on accidents are definitely necessary. Foremost among these, of course, is immediate, scientific investigation of accidents by trained officers.

1. Location of the accident.
2. Description of the highway, type of surface, condition, width, number of lanes, curvature, grade.
3. Diagram and description of surroundings, with movements of vehicles and persons.
4. Information about time of accident, weather, and light conditions.
5. Facts about the severity of the accident and extent of damage involved.
6. Type and maintenance of vehicles involved.
7. Information about drivers and their actions.
   a. Description—age, sex, experience, record, etc.
   b. Actions.
      (1) Violations.
      (2) Speeds.
   c. Physical condition.
      (1) Intoxication.
      (2) Fatigue, drowsiness, etc.

Each state requiring reporting of accidents has its own accident report form. Many cities have report forms which are different from the state form. A driver having an accident in an urban area may thus have to fill out a variety of report forms: one for the state; one for the city; and in addition, if he is insured, one for his insurance company, and if he is a commercial driver, one for his employer. It would be a great convenience for the driver if one standard report form could be agreed upon.

An agreement on a uniform report form is difficult, however, because of the different interests of the various concerns who make use of the accident information. Police departments are interested principally, in the list of data above, in items 6 and 7 regarding the personal blame of the operator and the condition of his vehicle, for they wish if necessary to prosecute him in court. A few police departments with well-trained traffic officers are also interested in items 1 to 6 bearing on the physical setting of accidents which may help them figure out what actually happened.

Highway departments want to find out exactly where accidents occur, so that they may determine what defects in the road may have contributed to the accident. They want information in great detail regarding items 1, 2, 3, and 4.

Motor vehicle departments summarize data on all points but are more concerned with items 5, 6, and 7. Much of the information desired by the highway engineer is of little value to the motor vehicle department.

Insurance companies and vehicle fleets are primarily interested in items 3, 5, 6, and 7. More than anything else they want to know whether their insuree or driver was to blame, and to gather such information as is available to defend him in court.

The general inefficiency of accident reporting has long been recognized. Back in 1924 the First National Conference on Street and Highway Safety recommended the compilation of complete, adequate, and accurate statistical information regarding traffic accidents. It also renewed earlier recommendations looking toward standard definitions of terms, reasonable uniformity in reporting and tabulating schedules, and the assembly of information regarding the causes of accidents.

It was not until more than a decade later, however, that a move for uniformity was made in the formation in May, 1937, of the Committee on Uniform Traffic Accident Statistics sponsored by the American Association of Motor Vehicle Administrators, the U. S. Census Bureau, the Interstate Commerce Commission, the National Safety Council, and other interested organizations. This Committee after a long period of inactivity has finally come forth with the lengthy recommended standard accident report form as shown on pages 130–131.

A number of objections have been made to the use of a report form as lengthy as that recommended by the Committee. One is that the average driver will resent filling it out. It is unquestionably true that to answer the fifty questions on the recommended accident report form takes at least a half hour, and most people do not want to spend so much time answering a lot of questions. On the other hand, it can be argued that half an hour spent in filling out an accident report form is not an unreasonable requirement to make of persons who fail to keep out of accidents. Filling out a complete accident report is an educational procedure of first importance to such a driver in that it forces him to describe the events and circumstances surrounding the accident and to some extent to analyze its causes.

The other argument against the use of a long form is that the ordinary driver is unable to fill it out adequately. The answer to this by the advocates of the form is that in several states which already use a form nearly as long as the recommended standard form, the average report is filled out just about as well as in those states which use a shorter form. To be sure, the average person tends to leave many questions unanswered in any questionnaire given him. But in spite of this general difficulty encountered in getting reports filled out, experience in using long forms indicates that the more questions are included on the form, the more are answered; a long report form thus actually procures more information than a short one.

No state can be expected to change from a short report form to a long one without meeting some opposition. Before a state can succeed in inducing drivers to fill out a long accident report form adequately, it must educate the public along these lines. All applicants should be taught how to fill out accident report forms accurately before they receive licenses. Licensed drivers should be given instructions in the correct way to fill

MAIL REPORT TO: BUREAU OF , DEPARTMENT OF ROOM , STATE HOUSE, (CITY)

LOCATION OF ACCIDENT

CITY Accident Occurred in _____ City or town _____ County

RURAL _____ miles North _____ miles South _____ miles East _____ miles West | OF _____ IN _____ City or town (state whether limits of or center of) County Township. Indicate exact mileage or distance, using two mileages and two directions if necessary.

ACCIDENT OCCURRED ON: Give name of street or alley or highway number (U.S., State, County). If no highway number, identify by name.

(Check and complete one) ☐ At intersection with _____ OR Give name of street or alley or highway number (U.S., State, County). If no highway number, identify by name.

☐ Not at intersection _____ feet North _____ feet South _____ feet East _____ feet West OF _____ Name (or otherwise identify) nearest intersecting street, house number, power or telephone pole (give number), highway, curve, bridge, railroad crossing, filling station, alley, driveway, culvert, guard-rail, mile post, underpass, overpass, or other identifying landmark. Show exact distance, using two distances and two directions if necessary. See diagram for further detail.

TIME OF ACCIDENT

Day _____ of the week

Date _____ 19__

Time _____ A.M. _____ P.M.

☐ Standard ☐ Daylight saving

TYPE OF ACCIDENT (Check one)

Collision of Motor Vehicle with:

☐ 1. Other motor vehicle.
☐ 2. Horsedrawn vehicle.
☐ 3. Railroad train.
☐ 4. Electric car.
☐ 5. Bicycle.
☐ 6. Other type of vehicle.
☐ 7. Fixed object _____ (Specify)
☐ 8. Pedestrian.
☐ 9. Animal (ridden, herded, unattended).
☐ 10. Non-collision (not the result of a collision—turned over, ran off roadway, fell from veh., etc.).

VEHICLE NO. 1

Year and Make _____ Type (such as sedan, cab, truck, bus, etc. Describe trailer, if any) _____ Registration _____ Year _____ No. _____ State _____

Direction _____ North, E., W., etc. On _____ Street name, highway No., alley, driveway, etc. Amount of damage to this vehicle $_____

Driven by _____ Name _____ Street, city and state address _____ Phone _____

Age _____ Sex _____ Driving experience _____ Years Driver's license _____ State _____ Number ☐ Chauffeur's ☐ Operator's _____ Occupation _____ Describe type, such as regular, junior, etc.

Owned by _____ Address _____ Phone _____

Distance danger of accident was first noted _____ Feet Estimated speed at that time _____ m.p.h. Estimated speed at moment of accident _____ m.p.h. Distance vehicle traveled after impact _____ Feet Lawful speed _____ m.p.h. Maximum safe speed under conditions prevailing _____ m.p.h.

VEHICLE NO. 2

Year and Make _____ Type (such as sedan, cab, truck, bus, etc. Describe trailer, if any) _____ Registration _____ Year _____ No. _____ State _____

Direction _____ North, E., W., etc. On _____ Street name, highway No., alley, driveway, etc. Amount of damage to this vehicle $_____

Driven by _____ Name _____ Street, city and state address _____ Phone _____

Age _____ Sex _____ Driving experience _____ Years Driver's license _____ State _____ Number ☐ Chauffeur's ☐ Operator's _____ Occupation _____ Describe type, such as regular, junior, etc.

Owned by _____ Address _____ Phone _____

Distance danger of accident was first noted _____ Feet Estimated speed at that time _____ m.p.h. Estimated speed at moment of accident _____ m.p.h. Distance vehicle traveled after impact _____ Feet Lawful speed _____ m.p.h. Maximum safe speed under conditions prevailing _____ m.p.h.

Damage to all property other than vehicles _____ Name object, show ownership, and state nature and amount of damage

KILLED OR INJURED

1. Name _____ Age _____ Sex _____ Address _____
Nature of Injuries _____ Was person killed? (Yes or no) _____ ☐ Driver ☐ Passenger Veh. No. _____ ☐ Pedestrian ☐ Other
Taken to _____ By whom _____

2. Name _____ Age _____ Sex _____ Address _____
Nature of Injuries _____ Was person killed? (Yes or no) _____ ☐ Driver ☐ Passenger Veh. No. _____ ☐ Pedestrian ☐ Other
Taken to _____ By whom _____

WITNESSES

Name _____ Address _____ Phone _____

Name _____ Address _____ Phone _____

ACTS OF PEDESTRIAN (Check one)

☐ 1. Crossing at intersection—with signal.
☐ 2. Same—against signal.
☐ 3. Same—no signal.
☐ 4. Same—diagonally.
☐ 5. Crossing not at intersection.
☐ 6. Coming from behind parked cars.
7. Walking in roadway (check two)
☐ a. With traffic.
☐ b. Against traffic.
☐ c. Sidewalks available.
☐ d. Sidewalks not available.
☐ 8. Standing in safety zone.
☐ 9. Getting on or off street car.
☐ 10. Getting on or off other vehicle.
☐ 11. Working in roadway.
☐ 12. Playing in roadway.
☐ 13. Hitching on vehicle.
☐ 14. Not in roadway.

MOVEMENT OF VEHICLES (Check one for each driver)

Vehicle 1 2 3
☐☐☐ 1. Making right turn.
☐☐☐ 2. Making left turn.
☐☐☐ 3. Making "U" turn.
☐☐☐ 4. Going straight ahead.
☐☐☐ 5. Slowing or stopping.
☐☐☐ 6. Starting from traffic lane.
☐☐☐ 7. Starting from parked position.
☐☐☐ 8. Stopped in traffic lane.
☐☐☐ 9. Parked.
☐☐☐ 10. Backing.

(Check applicable item)
☐☐☐ 1. Overtaking.
☐☐☐ 2. Avoiding vehicle, object or pedestrian.
☐☐☐ 3. Skidding.

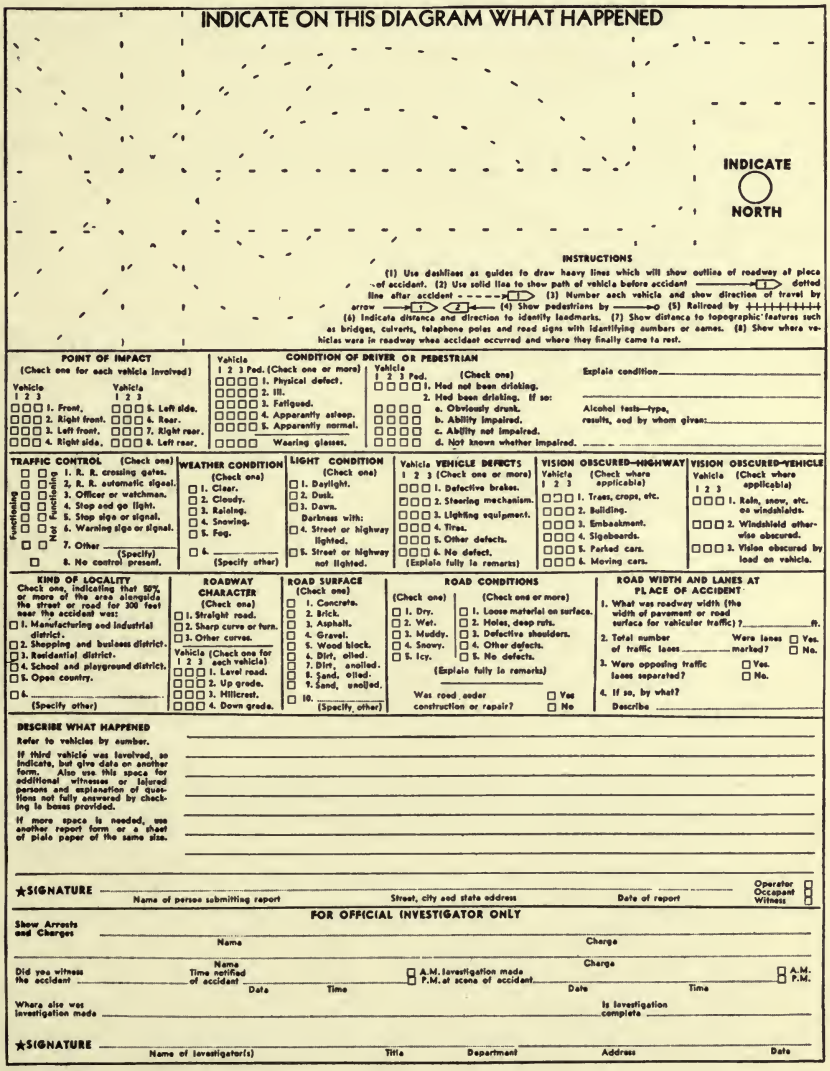
VIOLATIONS INDICATED (Check one or more for each vehicle)

Vehicle 1 2 3
☐☐☐ 1. Exceeding lawful speed.
☐☐☐ 2. Did not have right of way.
☐☐☐ 3. On wrong side of road.
☐☐☐ 4. Drove through safety zone.
☐☐☐ 5. Passing standing street car.
☐☐☐ 6. Passing on hill.
☐☐☐ 7. Passing on curve.
☐☐☐ 8. Cutting in.
☐☐☐ 9. Failure to signal or improper signal.
☐☐☐ 10. Improper turn—wide right turn.
☐☐☐ 11. Same—cut corner on left turn.
☐☐☐ 12. Same—turned from wrong lane.
☐☐☐ 13. Disregarded traffic control. (See Traffic Control Schedule)
☐☐☐ 14. Improper starting from parked position.
☐☐☐ 15. Other improper driving (explain).
☐☐☐ 16. No improper driving indicated.

Explain other violations _____

(*Front of Fig. 26.*)

out accident reports through newspapers and pamphlets distributed with license or registration renewals. It takes time and effort to train motorists to fill out accident report forms adequately, but work along this line is well worth the trouble, for good accident reporting is a prerequisite to efficient accident prevention.



INDICATE ON THIS DIAGRAM WHAT HAPPENED

INDICATE NORTH

INSTRUCTIONS

(1) Use dashlines as guides to draw heavy lines which will show outline of roadway at place of accident. (2) Use solid lines to show path of vehicle before accident ——▷ dotted line after accident - - - - ▷ (3) Number each vehicle and show direction of travel by arrow ——▷1 ◁2—— (4) Show pedestrians by ——o (5) Railroad by +-+-+-+-+-+ (6) Indicate distance and direction to identify landmarks. (7) Show distance to topographic features such as bridges, culverts, telephone poles and road signs with identifying numbers or names. (8) Show where vehicles were in roadway when accident occurred and where they finally came to rest.

POINT OF IMPACT (Check one for each vehicle involved)

Vehicle 1 2 3 — Vehicle 1 2 3
1. Front. 2. Right front. 3. Left front. 4. Right side. 5. Left side. 6. Rear. 7. Right rear. 8. Left rear.

CONDITION OF DRIVER OR PEDESTRIAN

Vehicle 1 2 3 Ped. (Check one or more)
1. Physical defect. 2. Ill. 3. Fatigued. 4. Apparently asleep. 5. Apparently normal. Wearing glasses.

Vehicle 1 2 3 Ped. (Check one)
1. Had not been drinking. 2. Had been drinking. If so: a. Obviously drunk. b. Ability impaired. c. Ability not impaired. d. Not known whether impaired.

Explain condition
Alcohol tests—type, results, and by whom given:

TRAFFIC CONTROL (Check one)
Functioning: 1. R. R. crossing gates. 2. R. R. automatic signal. 3. Officer or watchman. 4. Stop and go light. 5. Stop sign or signal. 6. Warning sign or signal. 7. Other (Specify)
Not Functioning
8. No control present.

WEATHER CONDITION (Check one)
1. Clear. 2. Cloudy. 3. Raining. 4. Snowing. 5. Fog. 6. (Specify other)

LIGHT CONDITION (Check one)
1. Daylight. 2. Dusk. 3. Dawn. Darkness with: 4. Street or highway lighted. 5. Street or highway not lighted.

Vehicle 1 2 3 VEHICLE DEFECTS (Check one or more)
1. Defective brakes. 2. Steering mechanism. 3. Lighting equipment. 4. Tires. 5. Other defects. 6. No defect. (Explain fully in remarks)

VISION OBSCURED—HIGHWAY Vehicle 1 2 3 (Check where applicable)
1. Trees, crops, etc. 2. Building. 3. Embankment. 4. Signboards. 5. Parked cars. 6. Moving cars.

VISION OBSCURED—VEHICLE Vehicle 1 2 3 (Check where applicable)
1. Rain, snow, etc. on windshields. 2. Windshield otherwise obscured. 3. Vision obscured by load on vehicle.

KIND OF LOCALITY
Check one, indicating that 50% or more of the area alongside the street or road for 300 feet near the accident was:
1. Manufacturing and industrial district. 2. Shopping and business district. 3. Residential district. 4. School and playground district. 5. Open country. 6. (Specify other)

ROADWAY CHARACTER (Check one)
1. Straight road. 2. Sharp curve or turn. 3. Other curves.
Vehicle 1 2 3 (Check one for each vehicle)
1. Level road. 2. Up grade. 3. Hillcrest. 4. Down grade.

ROAD SURFACE (Check one)
1. Concrete. 2. Brick. 3. Asphalt. 4. Gravel. 5. Wood block. 6. Dirt, oiled. 7. Dirt, oiled. 8. Sand, oiled. 9. Sand, unoiled. 10. (Specify other)

ROAD CONDITIONS
(Check one) 1. Dry. 2. Wet. 3. Muddy. 4. Snowy. 5. Icy.
(Check one or more) 1. Loose material on surface. 2. Holes, deep ruts. 3. Defective shoulders. 4. Other defects. 5. No defects.
(Explain fully in remarks)
Was road under construction or repair? Yes No

ROAD WIDTH AND LANES AT PLACE OF ACCIDENT
1. What was roadway width (the width of pavement or road surface for vehicular traffic)? ft.
2. Total number of traffic lanes — Were lanes marked? Yes No.
3. Were opposing traffic lanes separated? Yes. No.
4. If so, by what? Describe

DESCRIBE WHAT HAPPENED
Refer to vehicles by number.
If third vehicle was involved, so indicate, but give data on another form. Also use this space for additional witnesses or injured persons and explanation of questions not fully answered by checking in boxes provided.
If more space is needed, use another report form or a sheet of plain paper of the same size.

★SIGNATURE — Name of person submitting report — Street, city and state address — Date of report — Operator Occupant Witness

FOR OFFICIAL INVESTIGATOR ONLY

Show Arrests and Charges — Name — Charge — Name — Charge

Did you witness the accident — Time notified of accident — Date — Time — A.M. P.M. investigation made at scene of accident — Date — Time — A.M. P.M.

Where else was investigation made — Is investigation complete

★SIGNATURE — Name of investigator(s) — Title — Department — Address — Date

FIG. 26. Standard motor vehicle accident report form as recommended by the Conference on Uniform Traffic Accident Statistics (1941).

DEFINITION: MOTOR VEHICLE ACCIDENT [1]

A MOTOR VEHICLE ACCIDENT [2] *IS AN EVENT INVOLVING:*

A. A motor vehicle [3] in motion [4] or any part thereof, or any person or object carried, or any vehicle, person or object being towed or pushed, or set in motion by such motor vehicle while it is being used for purposes of travel or transportation—coming into contact with: [5]

- *a.* pedestrian; [6]
- *b.* another motor vehicle, or any part of the vehicle, occupants or load thereof, while moving or when stalled in traffic or parked, or any vehicle or object being towed or pushed by such motor vehicle;
- *c.* railroad train (includes stalled vehicle struck by railroad train);
- *d.* street car (includes stalled vehicle struck by street car);
- *e.* bicycle;
- *f.* animal-drawn vehicle;
- *g.* animal;
- *h.* fixed object;

B. A motor vehicle:

- *i.* overturning; or
- *j.* running off the roadway;

C. A person falling while riding with or without permission on or in a motor vehicle, or getting on or off a motor vehicle which is in motion;

D. The effect of a moving motor vehicle, or any of its parts, or its behavior, or its motion, or the motion of any part thereof, on the occupants, cargo, or vehicle itself (fires or explosions included);

E. Any other exceptional combinations of circumstances not covered by *A, B, C,* or *D* which are commonly and consistently classified as motor vehicle accidents by the agency concerned; [7]

AND RESULTING IN UNINTENTIONAL:

I. Human death;

II. Personal injury: [8]

1. to the extent of requiring medical or surgical attention;
2. of any nature, except as covered by "I," or "III" regardless of how minor it may be;

III. Damage to property: [8]

3. estimated to be more than $100;
4. estimated to be more than $50;
5. estimated to be more than $25;
6. estimated to be more than $10;
7. regardless of how minor it may be provided signs of contact are visible, or the impact was of such force as to lead to the conclusion that damage though not apparent may have resulted.

(Discussion of this definition and the examples which follow appears on page 135.)

Footnotes

[1] With this arrangement accidents may be designated as Ab–I, or Bi–II2, or C–III4 on the basis of the circumstances under which they occur, and their consequences. The capital and small letters classify accidents according to types, and the Roman and Arabic numerals indicate their consequences.

[2] Unless there is an indication to the contrary it is assumed that a motor vehicle accident is a traffic accident. A motor vehicle traffic accident is any motor vehicle accident occurring, or originating, or terminating, on a traffic way. A traffic way is the entire width between property lines (or other boundary lines) of every way or place or any part of which is open to the use of the public as a matter of right or custom for purposes of vehicular traffic. Thus a motor vehicle accident occurring on a driveway of a private home, in an industrial yard, on a race track, in a field, on the ice of a lake is not a traffic accident.

[3] A motor vehicle is any device self-propelled or propelled by electric power but not operated upon rails, and in, upon, or by which, any person or property is or may be transported or drawn upon a highway, except devices moved by human power.

[4] Motion of the vehicle is assumed unless the contrary is indicated.

[5] An accident involving a series of events is usually classified according to the first incident in the series; e.g., if a car turns over and then hits a pedestrian it should be classified as Bi rather than Aa. In general, a motor vehicle accident should be classified according to what happens first on the travelled roadway, not what happens after the vehicle leaves the roadway.

[6] Pedestrians include persons operating push carts, persons riding or moving a coaster, wagon, sled, scooter, tricycle, skates or skis; a baby in a carriage.

[7] Since the accidents under items C, D, and E represent only a small fraction of all accidents, the National Conference on Uniform Traffic Accident Statistics recommends that they be lumped in one category and classed as (k) type accidents. Item E is included to cover rare accidents and should be used as infrequently as possible. Unusual accidents which cannot be classified under A, B, C, or D should normally be submitted to the Conference on Uniform Traffic Accident Statistics for a decision as to whether they are motor vehicle accidents.

[8] Items II and III are divided into a number of sub-classifications for two purposes: (1) to enable an agency to compare its accident rate with that of another agency which has different requirements for reporting accidents, and (2) in order to gather facts to use in formulating a minimum standard, or standards, for reporting personal injury and property damage accidents which will be acceptable to federal and state agencies, vehicle fleets, and insurance companies.

It is, of course, unnecessary for an agency to subdivide II and III except when making comparisons with other agencies or for research purposes. Accidents of the severity of items I, III1, III3, III4, III5, and III6 are reportable under the laws of various states. The Uniform Vehicle Code at present recommends $25 as the minimum reportable property damage accident for states. But many insurance companies and commercial fleets in addition require reporting of minor personal injury and property damage accidents as covered in items II2 and III7.

EXAMPLES

The following are classified as motor vehicle accidents:

1. Driverless auto gets loose and causes damage or injury.
2. Wheel comes off car and hits bystander.
3. Auto hits pole and dislodges sign which falls on pedestrian.
4. Cargo escaping or falling from vehicle while moving and injures pedestrians or causes other accident.
5. Moving vehicle dislodges stone which flies up and hits pedestrian, or occupant of another vehicle.
6. Occupant is struck by an object not set in motion by another motor vehicle and as a consequence the vehicle becomes involved in an accident.
7. Injury or damage while pushing another car.
8. Injury or damage while towing another vehicle, trailer, bicycle, skier, sled.
9. Pedestrian's clothes catch on door handle and he is dragged and injured.
10. Injury or damage from collision with sleds or bicycles.
11. Motor vehicle stalled on railroad track where it is struck by train.
12. Motor vehicle parked or stalled in a dangerous position on the road where it is struck by a street car.
13. Motor vehicle overturns causing injury to occupants.
14. Motor vehicle runs off highway causing injury or damage but does not collide with anything.
15. Injury or damage from vehicle running off highway into body of water.
16. Injury to child who falls off vehicle while stealing a ride.
17. Wheel of motor vehicle comes off causing injury to occupants.
18. Occupant is injured by sudden start, acceleration, deceleration, or stop.
19. If injury or damage results from the detonation of explosives or the discharge of firearms carried on a vehicle the explosion shall be assumed in the absence of evidence to the contrary to have resulted from the motion of the vehicle.
20. The motion of the vehicle starts a fire.
21. Carbon monoxide poisoning while vehicle is in motion.
22. Getting on or off a standing bus which is being used for transportation.

The following are not classified as motor vehicle accidents:

23. Roadway surface is cracked or damaged by the weight and ordinary motion of a motor vehicle (but if vehicle or any property is damaged it becomes a motor vehicle accident).
24. Injury or damage from cranking, repairing, servicing or inspecting a standing motor vehicle. This includes motor vehicle falling from hoist, explosion of tire or gas tank, or fire.
25. Proved suicide or deliberate homicide (but if as a result of this action someone else is injured, the latter if not of homicidal intent is classified as a motor vehicle accident).
26. Injury or damage caused by falling or flying objects not set in motion by a motor vehicle and which do not result in loss of control of car or collision.
27. Injury or damage caused immediately and directly by lightning, floods, earthquakes, tornadoes, hurricanes and other cataclysms. But injuries and damages resulting later from vehicles colliding with obstacles left in road, or from washouts, or as a consequence of the driver being killed or injured by lightning, etc., are classified as motor vehicle accidents.
28. Injury or damage incurred immediately and directly as a consequence of war or invasion. But injuries and damages resulting later from vehicles colliding with obstacles left in the road or as a consequence of the driver being killed or injured by bombs, shells, etc., are classified as motor vehicle accidents.
29. Carbon monoxide poisoning in a garage or stationary vehicle.
30. A pedestrian injured while dodging or otherwise avoiding a motor vehicle but not struck by the vehicle.
31. Injury in connection with a motor vehicle that is on, or is being placed on or taken off, a boat or other water carrier, unless the motor vehicle is in motion under its own power.
32. Collision of a motor vehicle with an airplane in motion is an airplane accident (but collision of a car with a standing airplane is a motor vehicle accident).

Establishing a Standard Definition

One of the factors contributing to the lack of uniformity in accident-reporting practices has been the lack of a satisfactory definition of an automobile accident. Disagreements exist between different states, municipalities, commercial fleets, insurance companies, and military services as to the character of and the seriousness of the automobile accidents which should be reported. Admittedly it may take years before all these agencies procure sufficient funds and learn to appreciate the need for complete reporting of all accidents. In the meantime, however, if general agreement could be reached on a definition of a motor vehicle accident we will have established a common denominator for the use of agencies which desire to compare their accident standings.

The author has aided a research committee of an engineering society which is studying this matter in preparing a brief but comprehensive accident definition. This definition has been adapted so that it covers all the features of the proposed Manual of Definition recently formulated by the National Conference on Uniform Traffic Accident Statistics. It is to be hoped that such an abridged definition will eventually be adopted by the National Conference.

As will be seen by studying the definition, page 132, items *A*, *B*, *C*, *D*, and *E* refer to the character of the accident, and I, II, and III refer to its consequences. This arrangement furnishes a convenient means of coding an accident. Thus *Aa*–I would designate a collision between an automobile and a pedestrian resulting in death, *Bi*–II2 an accident involving a motor vehicle overturning, resulting in minor personal injury. By using this system of coding accidents two agencies could compare their accident standings. Thus if it were desirable to compare Fleet *A* which requires reporting of items *A*, *B*, *C*, *D*, *E*, I, II, and III and Fleet *B* which requires reporting of items *A*, *B*, I, II, it could be done by omitting all accidents of Fleet *A* which involved items *C*, *D*, *E*, and III.

Since accidents are so complicated and varied in scope it is necessary to list some examples to aid persons in using the definition, as well as to cover exceptions to the general rule. The examples which follow the definition give accepted practices as recommended by the National Conference on Uniform Traffic Accident Statistics.

IMPROVEMENT IN THE RECORDING, ANALYSIS, AND USE OF ACCIDENT DATA

If accident records are worth keeping, they are worth using. They must be readily available, summarized periodically, interpreted, and put to use.

Keeping Adequate Accident Records

The reason for poor accident-record keeping in most motor vehicle departments is lack of funds. Too rigid economy in the number of office assistants often results in slipshod work in filing records. With department space at a premium, old records are carelessly stored in inaccessible basements or attics. What is even worse, many state departments in their desire to economize on space make the mistake of throwing away accident records after they are two or three years old.

An accident record system is valuable to the extent that it fully and comprehensively covers the driving histories of all active drivers who have had accidents. As will be pointed out in Chapter IX, some drivers continue to have accidents over long periods of time. Unless, therefore, records are kept permanently it is almost impossible to pick out accident-repeater drivers effectively.

An accident-recording system contains the basic data upon which all accurate information about the safety status of the state is based. Without adequate accident reporting and recording, a state has no barometer of the extent or cost of its accidents. Plans for reducing accidents are absolutely dependent on an adequate knowledge of when, where, and why accidents occur.

Analyzing and Interpreting Accident Data

A good deal of valuable information is obtainable from state accident summaries, where these are available, about the times, places, and conditions under which accidents most commonly occur. Much of this material is particularly useful in making comparisons between states to determine differences in exposure.

A few state motor vehicle departments do not yet issue detailed analyses of traffic accident experience. In those which do, there is still room for improvement both in the analysis made of them, and in the use of the results obtained.

Correlation of Data as Now Obtained. Additional information of considerable importance could be secured by a more extensive intercorrelation of available accident data. Examples of possible studies are the following:

1. Tabulation each year of the previous accidents of operators in accidents that year, according to the lengths of time since their last accident. This information should be further subdivided according to drivers' sex, age, and years of driving experience.

2. Tabulation each year of the previous accidents of operators in accidents that year according to the total number incurred by each driver. This material should also be subdivided according to sex, age, years of driving experience, and according to whether the accidents were day-night, urban-rural.

3. Distributions of drivers in accidents during the different hours of the day according to the drivers' sex, age, and years of driving experience.

4. Correlation of sex, experience, and age of drivers in accidents with types of violations, and locations of accidents.

5. Estimations of the relative importance of the most common types of accidents which result primarily from (*a*) hazards arising from the presence of other users of the highway; (*b*) hazards inherent in the roadway; (*c*) hazards arising from poor visibility.*

6. Calculation of the ages of drivers in accidents involving drinking, and the time and location of these accidents.

7. Study of the hour of day, day of week, and month of year, of occurrence of motor vehicle accidents involving drinking and sober pedestrians, and of the ages and personal characteristics of victims.

Besides the suggestions above, from information now available in state accident files, many other important interrelationships of circumstances surrounding accidents and the characteristics of the drivers and pedestrians involved could be studied. Without such correlations the full value of the data collected cannot be realized.

A few states—including California, Connecticut, New Jersey, New York, Oregon, Pennsylvania, and South Carolina—occasionally make special research studies of the type discussed above,† but most state motor vehicle departments devote far too little time and money to research and fact gathering. They put out their summaries along a standard pattern and continue year after year to gather the same sort of information, hesitating to venture on new and untrodden paths. The resultant dearth of essential information about the nature of their special problems and about the effectiveness of their existing accident prevention activities handicaps them in their efforts to make the best possible use of the funds at their disposal, as well as in their attempts to convince the public that they deserve more support.

Suggestions for Additional Desirable Information. A number of factors which are not commonly included on state accident report forms, or in annual state summaries of accidents, but about which it would be valuable to have knowledge include:

* See Chapter II, for a discussion of these hazards.

† I am particularly indebted to William M. Greene and Hilda M. Keller of the Connecticut Motor Vehicle Department, and to Robert J. Maloy of the New York Bureau of Motor Vehicles for their helpful suggestions and assistance in gathering needed facts to round out this chapter.

1. Annual mileage of operators and vehicles.
2. Age and condition of vehicles.
3. Number of hours driven without rest prior to accident.
4. Trip distance on the day of the accident.
5. Purpose of trip.
6. Whether drivers are owners or non-owners.
7. Number of occupants of cars.
8. Occupations of operators.
9. Rural-urban residence of drivers and pedestrians.
10. Driving experience of operators.
11. Whether drivers are insured or uninsured.

Only a few states ask for information on these points on their accident report forms. States desiring such data will therefore have to include these items on their report forms.*

To determine the full significance of these factors it will, in addition, be necessary for states to correlate them with other facts about drivers. Thus, for example, the number of cars of different year models in fatal, personal injury, and property damage accidents may be of significance in determining the causes of accidents but such data are of little value unless we know something about the average annual mileages and the relative proportions of the vehicles of different year models registered in the state. In other words, every time we obtain information about a particular factor which influences accidents we should endeavor to relate these findings to other relevant facts such as exposure and to the general constitution of the drivers in that locality.

Let us take up the various items enumerated above and outline the information which it is desirable to obtain regarding them:

1. *Annual mileages of operators and vehicles.* In spite of the fact that exposure is a most important factor determining susceptibility to accidents only New York and Connecticut so far have attempted to gather information about the annual mileages of operators in accidents. Information about the annual travel of operators would be of value in throwing more light on the influence of exposure on accidents, and on the relative accident rates per mile driven by various types of drivers such as women drivers compared with men, young versus old, inexperienced versus experienced, commercial versus pleasure, and drivers by occupation and race. By comparing the average annual mileage of vehicles in accidents with the average annual mileage of all vehicles as gathered by the State Highway Planning Surveys, a better idea could be gained of the part played by this phase of exposure in accident causation.

2. *Age and condition of vehicle.* The question as to whether old cars incur relatively more accidents per mile traveled than new cars has never been satisfactorily answered. The only way to decide the point is to ask for car age and annual vehicle mileage on the accident report form and to compare the

* Even the recommended standard form (Figure 26) does not call for the information needed for items 1, 3, 4, 5, 6, and 11.

accident rates of cars of different vintages. Equally interesting is the question as to whether cars whose brakes, lights, and other safety equipment are in improper operating condition incur more accidents than vehicles in good mechanical condition. To answer this question the accident rates per mile driven of two groups of cars, one whose safety equipment was found on inspection to be in good condition, and the other whose safety equipment was defective, should be determined for a period of months prior to inspection. If it can be shown that vehicles in poor mechanical condition are in more accidents than cars in good condition then the argument for compulsory inspection of vehicles would be considerably strengthened.

3. *Hours driven without rest prior to accident.* In order to obtain much needed information about the relationship between accidents and fatigue it would be valuable to ask each motorist to state the number of hours he had driven during, say, the twelve hours preceding the accident.

4. *Trip distances of operators.* Since the distance a driver travels during the day seems to influence his speed (see Table 17) it may also influence his accident rate. In any case it would be valuable to obtain the daily trip length of operators involved in accidents to see if drivers on long trips have more than their share of accidents.

5. *Purpose of trip.* Not only the distance away of a motorist's destination, but also his reason for going there, may play an important part in determining whether he will arrive safely (see Table 4). It would be valuable if we could obtain information about the comparative accident rates of motorists on various kinds of trips such as: (*a*) business, (*b*) commuting to work, (*c*) recreational, (*d*) social, (*e*) shopping, (*f*) school, and (*g*) miscellaneous. No state includes either trip distance or purpose of trip on its accident record.

6. *Whether drivers are owners or non-owners.* There is an indication that non-owners have a higher accident rate than owners (see Chapter V). We need to corroborate this finding and in particular to learn more about the differences in characteristics of owner and non-owner-drivers—their ages, sex, speed, annual mileage, and the type and age of the vehicles they drive. Although many states obtain this information on their report forms, only two states include it on their accident summaries.

7. *Number of occupants of cars.* Since lone drivers travel somewhat faster than drivers with occupants (see Table 20) it would be valuable to find out how the accident rate varies according to the number of occupants, and to the relationship of the occupants to the driver.

8. *Occupation of operators.* There is an indication that differences exist in prevailing driving speeds and in accident susceptibility among occupational groups. To clarify this point we need information about the sex and age of the different groups and the annual mileage and the year models of the vehicles they drive, as well as their comparative accident rates and average driving speeds. In view of the marked increase in accidents recently, a segregation of the accident reports of all drivers into type of employment would help to determine to what extent increases in accident rates could be ascribed to operators engaged in emergency defense work, military or otherwise. Only five states obtain and summarize information on the occupations of drivers in accidents.

9. *Rural-urban residence of drivers and pedestrians.* Rural drivers seem to have fewer accidents than urban drivers (see Table 41). However, factual evidence on this point is scarce and there is a need to investigate the proportion of rural and urban licensed drivers, the annual mileage of those in accidents, the times and locations of their accidents, their ages, sex, and the ages of the vehicles they drive. More information on rural and urban pedestrians in accidents is likewise needed.

10. *Driving experience of operators.* A number of states now tabulate the driving experience of operators involved in accidents. But without figures on the number of licensed operators with different years of driving experience, and their mileages, ages, and sex, and the ages of the vehicles they drive, it is difficult to determine whether limited driving experience is really an important factor in accident causation.

11. *Whether drivers are insured or uninsured.* In the only state that has made a study of insured and non-insured drivers in accidents over a period of years, it was found that the proportion of non-insured operators in accidents is on the increase. [102, *524*] To corroborate this finding and to study the differences in accident rates among insured drivers in different states it would be valuable to include this item on the accident report form.

Use of Accident Data to Discover Causes of Accidents. The collection and use of accident data to discover causes of accidents is still in its infancy. The chief drawback to progress in this field lies in the inadequate information obtainable about the driver—what was on his mind and what he did just before the accident occurred. We can never expect the average driver to give us an accurate and complete report about himself. We have to infer his behavior from an investigation of the physical effects of the accident, and from the report of trained investigators. The most complete and satisfactory accident reports are those of specially trained investigators belonging to police departments or insurance companies who arrive at the scene of the accident shortly after it occurs, and before the vehicles have been removed and other physical signs of the accident have been obliterated.

A valuable attempt at analyzing the immediate and remote causes of accidents was carried out under the direction of the U. S. Public Roads Administration in Michigan in 1937. [233] The analysis sheet shown below, adapted from one developed by the National Advisory Committee on Aeronautics, was designed for the use of trained investigators in this study.

After investigating 30 accidents it was concluded that the driver was at fault 76 per cent of the time; the car 5 per cent; the road 11 per cent; and miscellaneous and undetermined factors 8 per cent. However, no sweeping conclusions as to highway accident causation can be drawn from this study on account of the small number of cases involved. Such a form, however, deserves to be given a fair trial. It might conceivably turn out to be as useful in analyzing automobile accidents as it has in analyzing airplane accidents.

In another study the Public Roads Administration scrutinized the case histories of 892 fatal highway accidents taken from the record files of several states. [236] Analysis showed that a large majority of the accidents resulted from a combination of causes to which varying degrees of importance could be attached in individual cases. A total of 2,524 causes

MOTOR VEHICLE ACCIDENT ANALYSIS FORM

CLASSIFICATION OF ACCIDENT	REMOTE CAUSES OF ACCIDENT																		
NUMBER _____	DRIVER									CAR			ROAD						
NATURE _____	Fitness			Ability				Will											
RESULTS _____	Physical handicaps	Mental defects	Sensory defects	Training as operator	Knowledge of laws	Knowledge of natural law	Mental sets	Predisposition	Distraction	Manufacture	Inspection	Maintenance	Design	Construction	Operation	Maintenance	Repair	Undetermined
DRIVER CLASS _____																			
CAR CLASS _____																			
ROAD CLASS _____																			
IMMEDIATE CAUSES OF ACCIDENT																			
DRIVER – ERRORS – Error of judgement																			
DRIVER – ERRORS – Poor technique																			
DRIVER – ERRORS – Carelessness																			
DRIVER – VIOLATIONS – Excessive speed																			
DRIVER – VIOLATIONS – Improper passing																			
DRIVER – VIOLATIONS – On wrong side of road																			
DRIVER – VIOLATIONS – Failure to slow, intersec.																			
DRIVER – VIOLATIONS – Improper turns																			
DRIVER – VIOLATIONS – Disregard traffic control																			
DRIVER – VIOLATIONS – Improper parking																			
CAR – STRUCTURE – Body																			
CAR – STRUCTURE – Frame																			
CAR – STRUCTURE – Steering mechanism																			
CAR – STRUCTURE – Springs, knee-action																			
CAR – STRUCTURE – Axles																			
CAR – STRUCTURE – Windshield and glass																			
CAR – EQUIPMENT – Wheels																			
CAR – EQUIPMENT – Tires																			
CAR – EQUIPMENT – Brakes																			
CAR – EQUIPMENT – Lights																			
CAR – ACCESSOR. – Free-wheel. - auto. clutch																			
CAR – ACCESSOR. – Extra lights																			
CAR – ACCESSOR. – Radio, sun-visor, etc.																			
CAR – ACCESSOR. – Mirror																			
ROAD – CHARACT. – Horizontal alignment																			
ROAD – CHARACT. – Vertical alignment																			
ROAD – CHARACT. – Road surface																			
ROAD – APP – Shoulders, ditches, etc.																			
ROAD – APP – Physical hazards																			
ROAD – CONTROL – Traffic Control																			
ROAD – CONTROL – Illumination																			
MISC. – Weather																			
MISC. – Light																			
MISC. – Speed																			
Undetermined																			

FIG. 27. Sample accident analysis sheet.

Source: "Skilled Investigation at the Scene of the Accident Needed to Develop Causes," *Motor-Vehicle Traffic Conditions in the United States*, Part 2, House Document 462, p. 10. U. S. Government Printing Office, Washington, 1938.

were tabulated, or about 3 causes per accident. The distribution of these causes is shown in the following table.

TABLE 35

DISTRIBUTION OF CAUSES OF 892 FATAL ACCIDENTS (1936)

Factor	Frequency of Occurrence	
	Number	*Per cent*
Speed excessive for conditions	636	25.2
Pedestrian's condition	417	16.5
Driver's negligence	361	14.3
Poor visibility	302	12.0
Temporary hazards in roadway	232	9.2
Pedestrian's faulty action	178	7.1
Driver's faulty action	155	6.1
Driver's condition	152	6.0
Faulty condition of motor vehicle	52	2.1
Faulty action of driver of vehicle other than a motor vehicle	21	0.8
Passenger's faulty action	16	0.6
Other factors	2	0.1

Source: "Case Histories of Fatal Highway Accidents," Part 5, *Motor Vehicle Traffic Conditions in the United States,* House Document 462, p. 14. U. S. Government Printing Office, Washington, 1938.

Other Uses of Accident Data. A small but substantial body of results which has accumulated so far testifies to the value of studying the significance of the facts revealed by accident reports. [5, 118, 144, 199, 268, 277, 281] Very little progress, however, has been made in most states and cities in using accident information. Some of the uses to which accident reports should be put are as follows:

1. To discover how many accidents there are, who has them, and where, and when, and why they occur.
2. To discover the real size of a state's or city's traffic accident problem and by comparison with other states or cities to arouse public pride over a good record, and indignation over a bad one.
3. To discover the types of drivers who are most violation- and accident-prone.
4. To indicate whither safety education can most effectively be directed. Ages of the persons most susceptible to accidents and the localities they live in are significant factors.
5. To furnish police and highway departments information about dangerous accident locations in the state so that they can take steps to reduce accidents at those points.

6. To make "before and after" studies when safety campaigns are operated, new highways are opened, police enforcement campaigns carried on, or safety education courses given, to indicate what types of prevention and enforcement are most successful.
7. To rate the safety activities of different counties, cities, and communities in the state.
8. To provide good material for newspaper publicity.
9. To dramatize the accident situation through posters, leaflets, exhibits, etc.

Inadequacy of Present Use of Accident Reports. A comprehensive survey of accident reporting in 38 states made a few years ago [234] showed clearly the inadequacy of the present use of accident reports. The survey found that only 9 states published comprehensive annual reports on their accident statistics. Six states were content with special statistical summaries. Twenty-four states made accident spot maps, but only 4 of them carried on special studies of the locations of accidents. In only 7 states were accident reports used to keep check of repeater-drivers, and only 3 states out of 38 made special enforcement studies based on accident reports. Such a neglect of the proper use of accident reports is most deplorable and should be remedied as speedily as possible.

RELATION OF COMPLETE ACCIDENT REPORTING TO THE CALCULATION OF THE COSTS OF MOTOR VEHICLE ACCIDENTS

The National Safety Council estimates that the direct costs of all deaths, injuries, and property damage resulting from motor vehicle accidents in the United States in 1938 amounted to $1,500,000,000. This includes damage to property, hospital and medical treatment for injured, wage losses of those disabled, and calculated life values of persons killed.

The Council offers two ways of calculating total accident costs. One uses only the number of deaths, assigning to each one a gross figure, the other assigns separate values to personal injuries and property damage accidents. [211]

1. *According to the Council's gross estimates:* wage loss, medical expenses, overhead costs of insurance, and property damage in all motor vehicle accidents in 1937 averaged about $45,000 per death. Since there were 32,582 fatalities in 1937, accident costs amounted to 32,582 times $45,000, or $1,466,190,000—or approximately one and a half billion dollars.
2. *Figuring on a divided basis, the Council assumes that:*

Each death costs	$11,500
Each personal injury accident	425
Each property damage accident	125

The $45,000 total cost for each death is thus figured as follows:

Cost per fatality	$11,500
Assuming 35 personal injuries for each fatality (35 times $425)	14,875
Assuming 150 property damage accidents per fatality (150 times $125)	18,750
Total cost per death	$45,125

Figures on accident costs for most parts of the country necessarily involve considerable guesswork at the present time. Better figures on numbers of personal injuries and property damage accidents are needed if we are to estimate more adequately the cost of accidents in separate states and cities. It is clear that if we ever want to do an accurate job of cost accounting on highway accidents, especially in the different states and cities where the proportions of different types of accidents vary, we must demand and be willing to pay for more complete accident reporting.

Uses of Accident Cost Accounting in Accident Reduction Efforts

Eventually we may find it more businesslike to allocate money for safety in proportion to the cost of highway accidents in the sections concerned, and to the savings expected from the use of certain proved methods of accident reduction. If we knew accurately how much accidents cost states or municipalities, and how much we could save in dollars and cents by disbursements for safety activities, it would be easier for driver control agencies to convince state and city authorities of the need of appropriating the necessary money for preventive activities. Legislatures and city councils are loath to spend money on activities which do not yield definite returns. Better accident reporting and cost accounting would help to show how much can be saved by the people of a state or city in return for definite expenditures. This hard-headed, dollars-and-cents attitude—which Americans understand—needs to be applied to our accident problem.

NECESSITY FOR IMPROVEMENT IN ACCIDENT REPORTING AND ANALYSIS

The present status of the collection, analysis, and use of accident reports over the country is not encouraging. However, some progress is being made and it seems reasonable to expect that continued efforts will eventually bring about a more satisfactory situation. Much of the misinformation concerning the causes of automobile accidents which today passes for

fact is the result of faulty interpretation of incomplete accident reports. Ineffective methods of collection, stereotyped and inadequate analysis are important reasons for our lack of sufficient information on which to base an effective attack on the automobile accident problem.

A few authorities in the field of highway safety have voiced the opinion that they already have the answer to the accident problem. Yet we keep witnessing the too familiar phenomenon of a rise in the number of accidents. The truth of the matter is that a great deal still remains to be done before we can say that we know much about the causes of accidents. Admission by safety authorities of their ignorance of the causes of accidents, combined with a zeal to overcome this ignorance, would herald the beginnings of wisdom.

CHAPTER VII

HOW HIGHWAY SAFETY IS MEASURED

To measure anything we need a yardstick or some convenient unit of measurement. The yardstick for measuring highway safety in, say, a state should obviously be the number of highway accidents which occur in that state. On this point all experts would agree. But the difficulty of using accidents as a measuring stick is that states have no reliable figures on the number of accidents which occur within their boundaries (see Chapter VI, p. 114). As a consequence safety authorities desirous of measuring the safety status of states have had to fall back upon a limited class of accidents whose consequences are so serious that they are reported quite reliably * in all states, namely, the accidents in which persons were killed.

The use of fatalities or fatal accidents as the basis for estimating safety status is, of course, highly unsatisfactory, principally because it is not a true indicator of all the accidents which occur in the state. Thus, as was pointed out in Table 31, the number of persons injured per fatality or the number of property damage accidents per fatality varies considerably from state to state depending upon a number of variables. Adequate reporting of personal injury accidents would enable us to make a more accurate appraisal of the safety standing of different states, whereas knowledge of serious property damage accidents would permit us to make still more reliable comparisons.

There are at present four general methods of ranking states according to safety status. They are according to (1) total motor vehicle deaths, (2) fatalities per population, (3) fatalities per registration, and (4) fatalities per vehicle-mile traveled. Let us take them up in the above order.

* The figures on automobile fatalities as furnished to the U. S. Bureau of Census are subject, however, to certain minor errors. For example, in the north central part of this country the reporting of deaths is somewhat unreliable, especially in the rural, sparsely inhabited counties where physicians are scarce. One of the best indications of defective reporting of mortalities in this region is the unusually low death rate. In sparsely populated areas reporting is generally less reliable than in highly urbanized regions.

RANKING OF STATES BY TOTAL MOTOR VEHICLE DEATHS

Figure 28 shows how the states rank in the number of automobile fatalities. As we should naturally expect, the states with the largest number of inhabitants, the most motor cars, and the most extensive vehicle usage have the most highway fatalities; just as the states with the sparsest population, the least number of motor cars, and lowest gasoline consumption have the fewest fatalities.

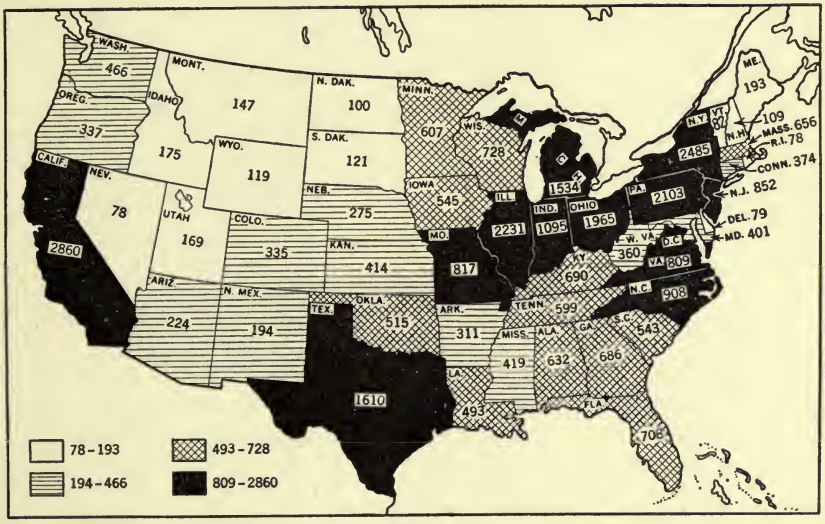


Fig. 28. Number of motor vehicle fatalities by states (1939).

Source: "United States: Motor Vehicle Accident Fatalities, 1939," *Vital Statistics—Special Reports*, 11 [51], 547 (January 30, 1941). Bureau of the Census, Washington.

It is interesting to note in Table 36, which divides into four groups the 48 states, ranked by their percentage of our total automobile fatalities, that the majority of highway accidents occur in a relatively few large, densely populated states. Thus two states, New York and California, have one-sixth of the total fatalities. To New York and California add Illinois, Pennsylvania, and Ohio, and we have five states which have one-third of the fatalities; to these five, add Texas, Michigan, and Indiana, and these eight states have nearly one-half; to these eight add North Carolina, New Jersey, Missouri, and Virginia, and these twelve states have three-fifths of the fatalities. Note also that the states in Group II collectively total 22 per cent of the total fatalities, those in Group III, 12 per cent; and those in Group IV, only 4 per cent.

TABLE 36

RANKING OF STATES BY PER CENT OF AUTOMOBILE FATALITIES (1939)
(Divided into four groups of twelve states each)

States	Per Cent of Fatalities	States	Per Cent of Fatalities
Group I		*Group* III	
California	8.83	Washington	1.44
New York	7.67	Mississippi	1.29
Illinois	6.89	Kansas	1.28
Pennsylvania	6.49	Maryland	1.24
Ohio	6.07	Connecticut	1.16
Texas	4.97	West Virginia	1.11
Michigan	4.74	Oregon	1.04
Indiana	3.38	Colorado	1.04
North Carolina	2.80	Arkansas	0.96
New Jersey	2.63	Nebraska	0.85
Missouri	2.62	Arizona	0.69
Virginia	2.50	New Mexico	0.60
Total	59.59	Total	12.70
Group II		*Group* IV	
Wisconsin	2.25	Maine	0.60
Florida	2.19	Idaho	0.54
Kentucky	2.13	Utah	0.52
Georgia	2.12	Montana	0.45
Massachusetts	2.03	South Dakota	0.37
Alabama	1.95	Wyoming	0.37
Minnesota	1.87	New Hampshire	0.34
Tennessee	1.85	North Dakota	0.31
Iowa	1.68	Vermont	0.25
South Carolina	1.68	Delaware	0.24
Oklahoma	1.59	Nevada	0.24
Louisiana	1.52	Rhode Island	0.24
Total	22.86	Total	4.47 [1]

[1] 0.38 fatalities at large.

Source: Same as for Figure 28, Chapter VII.

The ranking of states according to the number of persons killed on the highways is of value chiefly in enabling us to see the unequal distribution of fatalities over the nation as a whole. Thus Figure 28 tells us that the number of persons killed varies each year from less than 100 in some states (Nevada, Delaware, Rhode Island, Vermont) to over 2,000 in others (Pennsylvania, Illinois, New York and California). But ranking the states in this manner does not begin to tell us which are the safest states.

RANKING OF STATES BY FATALITIES PER POPULATION

In Figure 29, which shows how the states stand according to their fatalities per 100,000 population, the ranking of the states is quite different from that in Figure 28. Thus although New York and Pennsylvania have a large number of fatalities, in terms of fatalities per unit of population they compare very favorably with other states. And states like Wyoming,

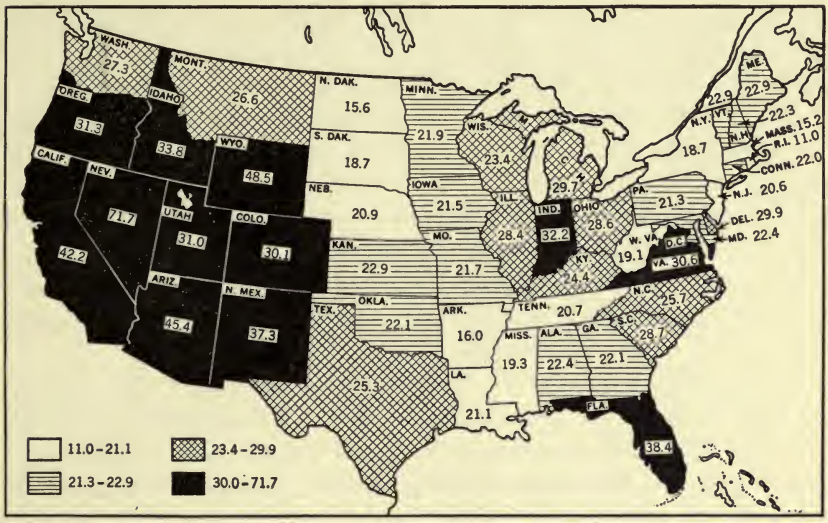


FIG. 29. State motor vehicle fatalities per 100,000 population (1939).
Source: "United States: Motor Vehicle Accident Fatalities, 1939," *Vital Statistics—Special Reports*, 11 [51], 547 (January 30, 1941). Bureau of the Census, Washington.

Idaho, and Nevada, which have few persons killed each year, rank poorly on a fatality per population basis.

This method of ranking states is the same as that used by vital statisticians in recording deaths from accidents of various sorts and from diseases. Thus it enables us to compare the risk of being killed in an automobile accident with the risk of death from other causes; and the risk a citizen of one state runs of being killed in an automobile accident, with the risk of a citizen of another state.

But this measure of safety status, although valuable, is not regarded so highly as either of the following—the fatalities per registered vehicle, or the fatalities per vehicle-mile—since the distribution of motor vehicles

and of miles traveled per vehicle vary considerably from state to state and are not properly allowed for by the fatality per population figures.*

RANKING OF STATES BY FATALITIES PER REGISTERED VEHICLE

Another way of estimating the safety status of states is to compare their fatalities with the number of vehicles registered.† This method takes into consideration the fact that the proportion of cars to population is not the same among the different states. Ranking states by this method tells us the risk that a vehicle in one state runs of being involved in a fatal accident as compared with the risk run by a vehicle in another state.

Figure 30 shows the way the states compare in this number of fatalities per registered vehicle. Although there are similaries between this map and the preceding one, they are by no means identical. The southeastern states as a group present a poorer showing on the latter map than on the former. The reason is that they are fairly densely populated, which favors them on a population basis, whereas they have relatively few vehicles per person, which lowers their standing on a fatality-per-vehicle basis.

States with a relatively low density of population and a high number of vehicles per person (see Figures 32 and 33, Chapter VIII), like California, Oregon, and Washington, on the other hand, improve their standing on a fatality-per-registered-vehicle basis as compared with a fatality-per-population ratio.

Since the number of vehicles in operation is naturally a better indication of the number of accidents those vehicles are likely to incur than

* Another handicap of the fatality per population figure is the difficulty of securing dependable annual figures on the population of states. Accurate figures on population are available only for the beginning of every decade, since our United States census is taken only once in ten years. During the intervening years we must rely on estimates. These estimates are admittedly subject to considerable error, on account of an unpredictable amount of migration from state to state resulting from economic conditions.

† Another valuable method of measuring safety would be on a basis of fatalities per licensed driver. Such a measure would indicate the risk that the driver of one state runs in being killed as compared to that of the driver in another state. But since Louisiana, South Dakota, and Wyoming do not yet license drivers, and since a number of other states license drivers permanently, or else for periods of several years, [9] only a few states can furnish accurate annual figures on the number of licensed drivers. It is therefore impossible at present to compare the safety of drivers in the different states on this basis. And we cannot estimate it from the number of vehicles per state since the ratio of drivers per vehicle varies in the different states (see Table 50).

is the number of persons in the state, the fatality-per-registered-vehicle ratio is regarded as a more logical indicator of safety status than the fatality-per-population ratio. But even knowledge of the number of vehicles, useful as it is, does not inform us about the actual exposure of those vehicles, or the number and relative danger of the hazards they encounter. Since the nearest gauge to exposure which we possess is miles

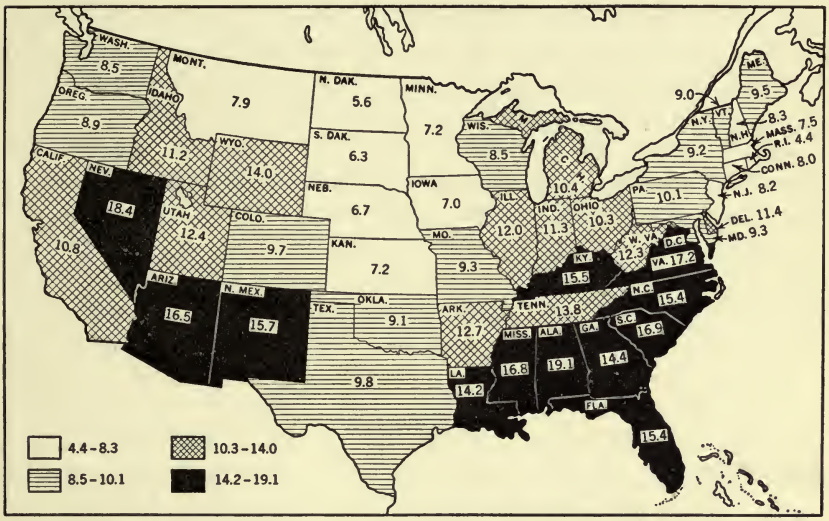


FIG. 30. Motor vehicle fatalities per 10,000 registered vehicles (1939).

Source: Fatalities: "United States: Motor Vehicle Accident Fatalities, 1939," *Vital Statistics—Special Reports*, 11 [51], 547 (January 30, 1941). Bureau of the Census, Washington.

Motor Vehicle Registrations: "State Motor-Vehicle Registrations, 1939," table MV-1, 1939, issued May, 1940. U. S. Public Roads Administration, Washington.

traveled, we shall next take up the fatalities per vehicle-miles traveled as perhaps the most generally useful single index of safety status at present available.

RANKING OF STATES BY FATALITIES PER VEHICLE-MILE

Other things being equal,* the less driving in a state, the fewer accidents the motorists in that state ought to incur. But it is difficult to obtain figures on the average annual mileage per vehicle. The U. S. Public

* Other things are, of course, seldom equal since the quality of the exposure varies, just as types of drivers and vehicles vary in the different states (see Chapter VIII).

Roads Administration is working to obtain estimates by car owners of the miles they travel annually in the different states, but has not yet secured figures for all states.

How the Amount of Travel in a State Is Determined

It is possible, nevertheless, to obtain estimates of the vehicle-miles traveled in each state * from the available figures on total gallons of gasoline consumed in each state. Figures on total gasoline consumption are furnished the federal government by wholesale petroleum distributors in each state in connection with payment of the federal gasoline tax. These figures are generally trustworthy, since the number of wholesale dispensers is relatively small and it is easy for the federal and state governments to check up on the accuracy of their sales reports.

It is difficult, however, to arrive at accurate figures on the amount of gasoline used only for highway purposes, in distinction from that purchased for farm, marine, industrial, and other non-highway uses. The reason is that in many states where no tax is charged on gasoline which is used for non-highway purposes, farmers, in particular, are inclined to run their automobiles with gasoline on which they have not paid a tax, and which they bought supposedly for agricultural purposes. In some states this illicit use of untaxed gasoline for highway purposes reaches fairly large proportions. In some midwestern states where the total reported consumption of gasoline is very much larger than the total gallons which are taxed, the illegal use of supposedly non-highway gasoline is particularly high. In 1936 in Kansas a study made for the legislature showed that about 50 per cent of the untaxed gasoline purchased in that state for agricultural purposes was actually used for highway purposes. [140] Therefore, if the motor vehicle death rate in Kansas for 1936 were figured in terms of the relation of fatalities to the total number of gallons of gasoline reported sold for highway use, the resulting figure would penalize Kansas's safety record, because many more gallons of gasoline were consumed on the highways than were reported.

In those states where the figures on highway use of gasoline are not furnished, the U. S. Public Roads Administration makes an attempt to estimate them. Its corrected figures on highway gasoline consumption are becoming more reliable each year. But more remains to be done to encourage states to determine just how much gasoline is consumed solely on their highways.

* The best available measure of safety status of cities is by fatalities per registered vehicle. Since gasoline consumption figures are not available for cities, fatality per vehicle-mile rates cannot be worked out.

Obviously the total gasoline consumption in a state should give a fairly good indication of the amount of automobile travel. But one catch in the use in this way of total gallons of gasoline consumed is that we do not know what mileage per gallon of gasoline consumed is obtained by the vehicles of a state. The U. S. Public Roads Administration's State Planning Surveys are gathering information on this point. Preliminary figures from a few states show that passenger cars now average about 16 miles per gallon, and trucks about 10 miles per gallon. The average for all vehicles (weighted for the proper proportion of passenger cars and trucks) is around 14 miles per gallon.* But the figures on the average number of miles traveled per gallon of gasoline vary somewhat from state to state.

These variations in mileages per gallon of gasoline obtained in different states can be attributed to differences in passenger car-truck ratio (trucks obtaining fewer miles per gallon), in proportion of urban driving (stop-and-go driving in cities lowering miles traveled per gallon), and in the proportion of high-priced, heavy vehicles (cheap, light vehicles using less gasoline per mile).

The Rating of States on a Fatality-per-Vehicle-Mile Basis

Figure 31 shows the states ranked in four groups according to their standing in fatalities per 100,000,000 vehicle-miles traveled. A comparison of Figure 31 with previous Figures 28, 29, and 30 shows that Figure 31 is more like Figure 30 than it is like the other two figures. Obviously by rating the states by fatalities per registered vehicle and by fatalities per vehicle-miles traveled we obtain similar results. The variations in standing are to be attributed chiefly to the relatively minor differences among states in the mileages obtained by their vehicles per gallon of gasoline.

The discussion of reasons why certain states have good safety records on a vehicle-mile basis, and why other states have poor records, will be reserved for Chapter VIII.

* For years it has been customary to translate general figures on gallons of gasoline consumed by motor vehicles into miles traveled. Having no valid data on number of miles obtained per gallon to go on, the figure of 13 miles per gallon for all types of vehicles was adopted. It will probably be desirable to continue to use this figure in order to be able to compare present-day figures on fatalities per vehicle-mile with those which we have of the past. Of course, the average mileage obtained by vehicles per gallon of gasoline may be improving slightly. But records of vehicle fleets over a period of years show vehicle mileage per gallon of gasoline to be about constant, since an improvement in efficiency of engines has been offset by an increased consumption of gasoline through faster driving.

Although the fatality-per-vehicle-mile rate is the standard measure of safety status it is far from perfect. A much better measure would be fatal and personal injury accidents per vehicle-mile, or all fatal and non-fatal accidents per vehicle-mile. Fatality-per-vehicle-mile rates should be supplemented wherever possible with information about other types of acci-

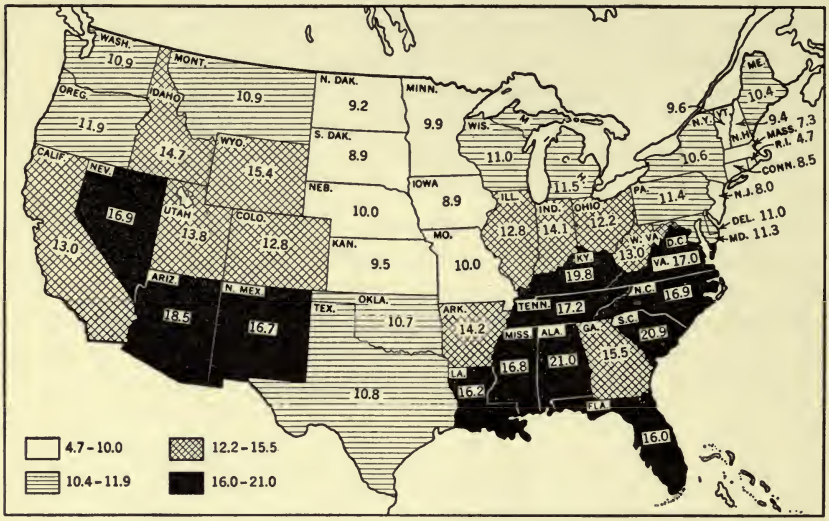


FIG. 31. State motor vehicle fatalities per 100,000,000 vehicle-miles (1939).

Sources: Fatalities: "United States: Motor Vehicle Accident Fatalities, 1939," *Vital Statistics—Special Reports,* 11 [51], 547 (January 30, 1941). Bureau of the Census, Washington.

Vehicle-miles: Adapted from gasoline consumption data in "Analysis of Motor-Fuel Usage in Calendar Year 1939," table G-21, 1939, issued November, 1940. U. S. Public Roads Administration, Washington.

dents and about other factors such as the nature of exposure and the kinds of vehicles and drivers involved (see Chapter VIII).

THE SAFETY RANKING OF STATES BY REGIONS

Having compared the states according to the various measures of safety status by rank order, let us now group them together in regions and see how the regions vary one from another. The most widely used regional classification of states is that of the U. S. Bureau of the Census, which divides them into nine sections: New England, Middle Atlantic, South Atlantic, East South Central, West South Central, East North Central, West North Central, Mountain, and Pacific. The following table gives

TABLE 37

REGIONAL RANKINGS OF STATES IN PER CENT OF FATALITIES, GASOLINE CONSUMPTION, MOTOR VEHICLE REGISTRATIONS, AND POPULATION (1939)

	Per Cent of Motor Vehicle Fatalities, 1939 [1]	Per Cent of Gasoline Consumption by Motor Vehicles, 1939 [2]	Per Cent of Motor Vehicle Registrations, 1939 [3]	Per Cent of Population, 1940 [4]
New England	4.62	7.01	6.27	6.40
Maine	0.60	0.69	0.66	0.64
New Hampshire	0.34	0.43	0.43	0.37
Vermont	0.25	0.32	0.29	0.27
Massachusetts	2.03	3.32	2.82	3.28
Rhode Island	0.24	0.62	0.57	0.54
Connecticut	1.16	1.63	1.50	1.30
Middle Atlantic	16.79	19.53	18.75	20.92
New York	7.67	8.71	8.67	10.24
New Jersey	2.63	3.96	3.36	3.16
Pennsylvania	6.49	6.86	6.72	7.52
South Atlantic	14.36	11.31	10.56	13.52
Delaware	0.24	0.27	0.22	0.20
Maryland	1.24	1.31	1.39	1.38
District of Columbia	0.48	0.71	0.54	0.50
Virginia	2.50	1.76	1.51	2.03
West Virginia	1.11	1.03	0.94	1.45
North Carlina	2.80	1.99	1.90	2.71
South Carolina	1.68	0.96	1.04	1.44
Georgia	2.12	1.64	1.54	2.37
Florida	2.19	1.64	1.48	1.44
East South Central	7.22	4.62	4.70	8.19
Kentucky	2.13	1.29	1.43	2.16
Tennessee	1.85	1.29	1.40	2.22
Alabama	1.95	1.12	1.07	2.15
Mississippi	1.29	0.92	0.80	1.66
West South Central	9.04	9.25	9.02	9.93
Arkansas	0.96	0.81	0.79	1.48
Louisiana	1.52	1.13	1.12	1.80
Oklahoma	1.59	1.78	1.82	1.78
Texas	4.97	5.53	5.29	4.87

TABLE 37—(*Continued*)

	Per Cent of Motor Vehicle Fatalities, 1939 [1]	Per Cent of Gasoline Consumption by Motor Vehicles, 1939 [2]	Per Cent of Motor Vehicle Registrations, 1939 [3]	Per Cent of Population, 1940 [4]
East North Central	23.33	22.68	22.83	20.22
Ohio	6.07	5.95	6.16	5.25
Indiana	3.38	2.89	3.13	2.60
Illinois	6.89	6.45	6.01	6.00
Michigan	4.74	4.93	4.76	3.99
Wisconsin	2.25	2.46	2.77	2.38
West North Central	8.88	11.12	12.46	10.27
Minnesota	1.87	2.28	2.74	2.12
Iowa	1.68	2.28	2.50	1.93
Missouri	2.52	3.02	2.84	2.87
North Dakota	0.31	0.40	0.57	0.49
South Dakota	0.37	0.50	0.62	0.49
Nebraska	0.85	1.02	1.33	1.00
Kansas	1.28	1.62	1.86	1.37
Mountain	4.45	3.71	3.91	3.15
Montana	0.45	0.50	0.60	0.43
Idaho	0.54	0.44	0.51	0.40
Wyoming	0.37	0.29	0.27	0.19
Colorado	1.04	0.97	1.11	0.85
New Mexico	0.60	0.43	0.40	0.40
Arizona	0.69	0.45	0.44	0.38
Utah	0.52	0.46	0.44	0.42
Nevada	0.24	0.17	0.14	0.08
Pacific	11.31	10.77	11.49	7.40
Washington	1.44	1.58	1.76	1.32
Oregon	1.04	1.05	1.21	0.83
California	8.83	8.14	8.52	5.25

N. B.: At large, 0.01 motor vehicle registrations.

Source: 1 Fatalities: "United States: Motor Vehicle Accident Fatalities, 1939," *Vital Statistics—Special Reports,* 11 [51], 547 (January 30, 1941). Bureau of the Census, Washington.

2 Gasoline consumption: "Analysis of Motor-Fuel Usage in Calendar Year, 1939," Table G-21, 1939, issued November, 1940. U. S. Public Roads Administration, Washington.

3 Motor vehicle registrations: "State Motor-Vehicle Registrations, 1939," Table MV-1, 1939, issued May, 1940. U. S. Public Roads Administration, Washington.

4 Population: "Final Population Figures for the United States, by States, 1940." Bureau of the Census, Washington.

the relative percentages for these sections of motor vehicle fatalities, gasoline consumed, registered vehicles and population.

New England, consuming 7.0 per cent of the gasoline, possessing 6.3 per cent of the vehicles, and 6.4 per cent of the population, incurs only 4.6 per cent of the fatalities. On any current method of figuring, therefore, New England is well above the average for the country in highway safety. Note that each New England state has a lower percentage of fatalities than gasoline consumed, registered vehicles, or population.

In the Middle Atlantic region, gasoline consumption, vehicle registrations, and population are higher than motor vehicle fatalities. Each state in the group also has a superior safety status on all three standpoints.

The South Atlantic states, on the other hand, have on the average a higher rate of fatalities than of gasoline consumed, vehicles registered or population; although in this group Delaware, Maryland, and the District of Columbia are superior to the other states, Maryland and the District of Columbia having a smaller proportion of fatalities than of the other three items.

The East South Central states have many more fatalities in proportion to the gasoline consumed and the number of vehicles registered. Their favorable standing on a population basis reflects the fairly high density of population in these states. Note that each state in the group has a poor safety rating on everything but population.

The West South Central states on the whole have a more favorable safety status on a gasoline consumption and population basis, but on account of a fairly low vehicle registration, rate lower from that standpoint. In this group Oklahoma has a good rating on all points. Texas has a fine fatality rate per gallon of gasoline consumed and per registered vehicle, but a poor rate per population. Both Arkansas and Louisiana have poor rates per gallon of gasoline consumed and motor vehicles registered, and good rates per population.

The East North Central states as a group have a poor rating in all respects, but Wisconsin is superior on all points, and Michigan good on gasoline and registrations, but poor on a population basis. Ohio is good on a vehicles-registered standpoint but poor on the others. Both Indiana and Illinois are below par in all three respects.

The West North Central states individually and collectively have a superior rating in all respects.

The Mountain states, on the other hand, have a collectively poor rate on all counts. Montana stands above the rest, since it is the only state in this group whose percentage of motor vehicle fatalities does not rank higher than that of the other items, except for Colorado which is superior with respect only to registrations.

The Pacific states as a group have a very low standing per population, an inferior standing per gasoline consumed, and an above average standing per registration. It is to be noted that California has a lower standing than Oregon and Washington.

THE SAFETY RANKING OF STATES BY GASOLINE CONSUMPTION GROUPS

Still another way to examine the safety record of states is to consider their relative number of fatalities when grouped according to the amount of gasoline used on their highways. By this method states with comparable amounts of vehicle travel are brought together for comparison.

The following table shows the 48 states grouped in six classes according to the amount of gasoline consumed (the ranking of states within a group is by fatality per vehicle-mile, not by amount of gasoline consumed). In the first group more than 820 millions of gallons of gasoline were consumed on the highways of each state in the year 1939. Drivers in states in the second group used between 369 and 688 millions of gallons of gasoline in 1939, and so on down until in the sixth group less than 92 millions of gallons of gasoline were consumed in each state during the year.

In Group I, New Jersey heads the list with the best fatality rate per vehicle-mile for that group and California appears at the end of the list. In Group II, Massachusetts leads with North Carolina at the bottom. In Group III, Connecticut is out in front, with Tennessee bringing up the rear. Nebraska is ahead in safety in Group IV, in which Alabama comes last. In Group V, Rhode Island is at the top with Arizona at the foot. In Group VI, North Dakota is first and Nevada last.

Rhode Island, in Group V, had the lowest mileage fatality rate in the United States in 1939. Massachusetts had the next lowest rate of 7.3, whereas New Jersey ranked third with 8.0. Alabama evidenced the highest rate, followed closely by South Carolina and Kentucky.

It will be noted that the states in Group I show the least difference in their mileage fatality rates. States with lower gasoline consumption show a wider range of mileage rates. Particularly noticeable is Group V with Rhode Island having a rate of 4.7 and Arizona one nearly four times as high. In four groups small densely populated states lead their groups: New Jersey, Massachusetts, Connecticut, and Rhode Island. The states with the poorest records are mostly southern and Rocky Mountain states.

TABLE 38

COMPARISON OF MOTOR VEHICLE FATALITY RATES OF STATES WITH COMPARABLE GASOLINE CONSUMPTION, 1939

(Average [1] for United States, 12.0)

Ranking per Vehicle-Mile	Average [1]
Group I—Over 820 million gallons of gasoline	
New Jersey	8.0
New York	10.6
Texas	10.8
Pennsylvania	11.4
Michigan	11.5
Ohio	12.2
Illinois	12.8
California	13.0
Group rate	11.3
Group II—Between 369 and 688 million gallons of gasoline	
Massachusetts	7.3
Iowa	8.9
Minnesota	9.9
Missouri	10.0
Oklahoma	10.7
Wisconsin	11.0
Indiana	14.1
North Carolina	16.9
Group rate	11.1
Group III—Between 268 and 366 million gallons of gasoline	
Connecticut	8.5
Kansas	9.5
Washington	10.9
Maryland	11.3
Georgia	15.5
Florida	16.0
Virginia	17.0
Tennessee	17.2
Group rate	13.2
Group IV—Between 199 and 268 million gallons of gasoline	
Nebraska	10.0
Oregon	11.9
Colorado	12.8
West Virginia	13.0
Louisiana	16.2
Kentucky	19.8
South Carolina	20.9
Alabama	21.0
Group rate	15.7
Group V—Between 93 and 192 million gallons of gasoline	
Rhode Island	4.7
South Dakota	8.9
Maine	10.4
Montana	10.9
Utah	13.8
Arkansas	14.2
Mississippi	16.8
Arizona	18.5
Group rate	12.3
Group VI—Under 92 million gallons of gasoline	
North Dakota	9.2
New Hampshire	9.4
Vermont	9.6
Delaware	11.0
Idaho	14.7
Wyoming	15.4
New Mexico	16.7
Nevada	16.9
Group rate	12.8

[1] Fatalities per 100,000,000 vehicle-miles.

Source: Fatalities: "United States: Motor vehicle accident fatalities, 1939," *Vital Statistics—Special Reports,* 11 [51], 547 (January 30, 1941). Bureau of the Census, Washington.

Vehicle-miles: Adapted from gasoline consumption data in "Analysis of Motor-Fuel Usage in Calendar Year, 1939," Table G-21, 1939, issued November, 1940. U. S. Public Roads Administration, Washington. Gasoline consumption data taken from same source.

VARIATIONS IN SAFETY STATUS IN THE UNITED STATES DURING THE LAST FIFTEEN YEARS

Let us consider the progress we have made in highway safety in the United States during the past fifteen years using as gauges the four different measures of safety status we have discussed.

The table below reveals some startling discrepancies in the reporting of safety progress obtained by the use of different measures of safety status. Thus total fatalities increased from 1926 up to 1931, then declined slightly during 1932 and 1933 during the depression when registrations and gasoline mileages were down. But in 1934, 1935, and 1936

TABLE 39

HIGHWAY SAFETY PROGRESS IN THE UNITED STATES, 1926–1940, MEASURED BY DIFFERENT STANDARDS

Year	Total Fatalities	Fatalities per 100,000 Population	Fatalities per 10,000 Vehicles	Fatalities per 100,000,000 Vehicle-Miles
1926	23,431	20.1	10.6	18.0
1927	25,796	21.8	11.1	17.7
1928	27,996	23.3	11.4	17.4
1929	31,215	25.7	11.7	17.3
1930	32,929	26.8	12.4	17.4
Avg. 1926–30	28,273	23.5	11.5	17.5
1931	33,675	27.2	13.0	17.0
1932	29,451	23.6	12.2	16.1
1933	31,363	25.0	13.2	17.1
1934	36,101	28.5	14.4	18.4
1935	36,369	28.5	13.9	17.4
Avg. 1931–35	33,391	26.5	13.2	17.2
1936	38,089	29.7	13.5	16.4
1937	39,643	30.7	13.3	15.9
1938	32,582	25.0	11.1	12.8
1939	32,386	24.7	10.6	12.0
1940	34,500	26.2	10.8	12.1
Avg. 1936–40	35,440	27.2	11.8	13.8
1941	40,000 (est.)	30.1 (est.)	11.8 (est.)	12.6 (est.)
1926–30 compared with 1936–40	+25.3	+15.7	+2.6	−21.2

Source: *Accident Facts*, 1941. National Safety Council, Chicago.

fatalities again shot up to reach a peak of 39,643 in 1937. They declined in 1938 and 1939 and then increased in 1940, and according to an estimate for 1941 have reached an all-time high of 40,000.

Fatalities per population showed a similar trend, indicating that the highway fatalities were increasing much faster than the population of the country.

Fatalities per registered vehicles showed an increase up to 1931, then rose to a peak in 1934, after two years of low registrations. With the steady increase in the number of registered vehicles since 1934 the fatality-per-registered-vehicle rate has steadily declined.

Fatalities per vehicle-mile showed a decline from 1926 to 1932. Then as the gasoline consumption dropped during the depression the fatality-per-vehicle-mile rate rose. Since 1934, however, with rising gasoline consumption the fatality-per-vehicle-mile rate steadily declined until 1939. But 1940 was no better than 1939 and during 1941 fatalities per vehicle-mile were more than those for 1939 and 1940.

According to the four standards we are using, during the 1936–1940 period as compared with the 1926–1930 period, it appears that safety has improved by 21 per cent according to the fatality-per-vehicle-mile rating, and to have declined 2 per cent according to the fatality-per-registered-vehicle rating, 15 per cent according to fatality per population, and 25 per cent according to total fatalities.*

WHAT IS THE PURPOSE OF MEASURING SAFETY STATUS?

Safety leaders are particularly fond of pointing with pride to the reduction of fatalities per 100 million vehicle-miles during the last few years and of ignoring the figures on total fatalities, fatalities per 100,000 population, and fatalities per 10,000 vehicles, all of which are decidedly less flattering. They are also prone to ignore the influence of periods of depression and prosperity and other factors which affect highway accidents in addition to the particular type of organized safety activities which they are promoting.

The point should be emphasized here that we should not blind ourselves to the broader view of the highway accident situation by relying solely on one measure of safety progress. The gathering of statistics and the measurement of safety status should be used to help us to understand the whys and wherefores of accidents, and not, as is so often true at present, to justify none too successful efforts at accident reduction. Safety leaders would serve the interests of safety more fairly if they were frank

* By comparing progress on the basis of five-year intervals minor variations are ironed out and general trends over a period of years are more clearly indicated.

with the public about lack of progress in accident reduction and made use of all available measures of safety including those which are less congratulatory.

Using the four measures discussed in this chapter, each state safety authority should strive to compare his state's standing with those of other states in the light of the drivers and vehicles in his state and the hazards which they encounter. Only in this way can he make any really worthwhile estimate of the comparative safety standing of his state, and plan effectively how to better its position.

Before we can expect to obtain a true picture of the national accident situation, or compare the status of states in different sections of the country, it will be necessary for each state to obtain authentic figures not merely on fatalities, but also on non-fatal and serious property damage accidents within its boundaries. Ultimately when reporting of non-fatal accidents is compulsory and standardized throughout the country, estimations of the highway safety status of states will be considerably more accurate.

CHAPTER VIII

THE HIGHWAY SAFETY STATUS OF STATES

THE NECESSITY OF SUPPLEMENTING THE FATALITY-PER-VEHICLE-MILE INDEX OF SAFETY STATUS WITH OTHER RELEVANT DATA

Motor vehicle and police administrators and other safety authorities the country over are frequently disturbed by the fact that the safety standings of their respective states are not correlated with the extent or cost of safety activities carried on, or with other related factors, such as the efficiency with which the driver license laws are administered, the number of state police employed, or the amount of money spent on highway and traffic engineering. North and South Dakota, for example, have carried on very few safety activities until quite recently. South Dakota does not even have a driver license law. These two states, nevertheless, have very low fatality rates; lower in fact than many states which have spent considerable sums of money over periods of years on highway safety.

It is necessary, therefore, that we keep in mind that our most commonly used index of safety status—fatalities per vehicle-mile—fails to give a really comprehensive and true picture of a state's safety standing unless supplemented by additional information. To be comprehended in its entirety, a state's highway accident problem, like that of an individual's, needs to be viewed broadly.

FACTORS INFLUENCING SAFETY STATUS

As we have pointed out in previous chapters, if we want to determine with some degree of precision an individual's susceptibility to accidents, we must secure a report on all the accidents he has incurred, non-fatal as well as fatal (see Chapter VI), and we must study his exposure, driving speed, skill, and safety-mindedness (see Chapters II, III, IV, and V). If we desire to obtain a reliable estimate of a state's safety status we should not permit ourselves to depend solely on such a dubious measure as the fatality-per-vehicle-mile index, but be prepared to take into account such factors as:

1. A wider sampling of all the automobile accidents which occur in the state, such as non-fatal accidents.

2. Differences in the exposure to which the drivers are subjected in addition to total miles driven.

3. Differences in driving speeds.

4. Differences in the drivers themselves, their general aptitude, attitude, and training.

5. Differences in the motor vehicles.

A standard safety program cannot be applied with equal success in different parts of the country. Safety programs have to be adapted to fit the particular requirements of individual states. A true perspective of the needs of a state is often lacking because of too limited accident data, of the ignorance of its authorities of the part played by the peculiar type of hazards encountered on its highways, of ignorance of prevalent driving speeds, and of an insufficient understanding of the characteristics of its drivers and vehicles.

It should be made clear here that the author does not underestimate or minimize the significance of existing organized safety activities. He does feel strongly, however, that if state safety authorities had the facts necessary for a better understanding of their problems, they would thereby be able to plan ahead more effectively and to hit the bull's eye more often.

Changes of Safety Status That Would Be Brought About by a Wider Sampling of Accidents

Fatal accidents commonly represent only a very small percentage of the total accidents reported in a state. For example, in the table below

TABLE 40

Comparison of Urban and Rural Fatalities and Injuries, and of Fatalities and Total Accidents

(Michigan, 1939)

	Cities and Villages		Rural Roads	
	Number	*Per cent*	*Number*	*Per cent*
Fatalities	590	2.8	987	11.0
Injuries	20,467	97.2	7,998	89.0
Total	21,057	100.0	8,985	100.0
Fatalities	590	.7	987	8.3
Total Accidents	81,050	99.3	10,915	91.7
Total	81,640	100.0	11,902	100.0

Source: Furnished by the U. S. Public Roads Administration.

we see that on urban roads in Michigan fatalities constitute only 0.7 per cent of all accidents and 2.8 per cent of all injuries. On rural highways on the other hand fatalities amount to 8.3 per cent of all accidents and 11 per cent of all injuries. It follows, therefore, that the use of a larger proportion of reported accidents would change the standing of states with different proportions of urban and rural travel.

A glance at Table 41, which presents the same data in different form, shows us that in this state, fatal accidents are approximately two-fifths

TABLE 41

PER CENT OF FATALITIES, INJURIES AND TOTAL ACCIDENTS, IN CITIES AND VILLAGES AND ON RURAL ROADS

(Michigan, 1939)

Location of Accident	Fatalities		Injuries		Total Accidents		Vehicle-Miles of Travel
	Number	*Per cent*	*Number*	*Per cent*	*Number*	*Per cent*	*Per cent*
Cities and villages	590	37.4	20,467	71.9	81,050	88.1	46.0
Rural roads	987	62.6	7,998	28.1	10,915	11.9	54.0
Total	1,577	100.0	28,465	100.0	91,965	100.0	100.0

Source: Same as that for Table 40.

less on city streets than on rural highways, whereas injuries are approximately two and a half times and total accidents almost eight times more on city streets than on rural highways. Note also that in spite of the low proportion of less serious accidents the total travel on rural highways was more (54 per cent) than on city streets (46 per cent).

Basing a state's safety standing on fatalities alone is, therefore, likely to be misleading, since the non-fatal accidents, which are ignored, vary widely from state to state according to the degree of urbanization and to other factors.

THE INFLUENCE OF DIFFERENCES IN EXPOSURE ON STATE SAFETY STATUS

In addition to knowing how much travel there is in a state, it is important also to know something about where and when the traveling is done, for as was pointed out earlier (Chapter II) the hazards to which drivers are exposed vary considerably from place to place and from time to time.

The number of vehicles and pedestrians encountered, together with imperfections in the roadway itself, and differences in climatic conditions

constitute the three most important types of hazards which vary our driving exposure as we travel from place to place.

Effect on State Safety of Hazards Arising from Extent of Use of the Highway. Differences in the number of other motorists and pedestrians encountered on the roads of a state are bound to affect the dangers of driving in that state. Among the best indicators of the total amount of travel on the highways of a state is the number of vehicles per mile of road. Other factors influencing the safety standing of a state which we shall also take up here are the number of vehicles per inhabitant and the density of population and degree of urbanization.

Effect of Numbers of Vehicles per Mile of Road. The table below shows how the states rank in the number of vehicles per mile of highway. Gen-

TABLE 42

VEHICLES PER MILE OF RURAL HIGHWAY BY STATES (1939)
(Average for United States, 10.5)

Rank of State	Vehicles per Mile	Rank of State	Vehicles per Mile
1. Rhode Island	78.1	25. Missouri	7.7
2. New Jersey	44.4	26. Iowa	7.5
3. Connecticut	39.8	27. Oregon	7.5
4. Massachusetts	36.6	28. South Carolina	7.4
5. New York	31.9	29. Minnesota	7.2
6. California	26.2	30. Tennessee	6.9
7. Maryland	25.3	31. Vermont	6.8
8. Pennsylvania	23.7	32. Utah	6.2
9. Ohio	22.3	33. Oklahoma	5.6
10. Illinois	18.1	34. Idaho	5.5
11. Delaware	17.8	35. Alabama	5.4
12. Michigan	15.9	36. Georgia	4.9
13. Florida	15.7	37. Arizona	4.8
14. Indiana	12.7	38. Colorado	4.6
15. Washington	11.1	39. Arkansas	4.5
16. Wisconsin	10.4	40. Kansas	4.5
17. Virginia	10.3	41. Mississippi	4.1
18. North Carolina	10.1	42. Nebraska	4.1
19. New Hampshire	9.7	43. New Mexico	3.9
20. Maine	9.1	44. Wyoming	3.6
21. Louisiana	8.7	45. Montana	2.8
22. Texas	8.7	46. South Dakota	1.9
23. West Virginia	8.5	47. Nevada	1.8
24. Kentucky	7.8	48. North Dakota	1.6

Sources: Rural highways: Table "State of Improvement of All Rural Highways," *American Highways*, 19 [1], 8–9 (1939); except New Mexico which was taken from "State Statistics Relating to Roads," National Highway Users Conference.

Vehicles: Table MV-1 "State Motor-Vehicle Registrations, 1939," issued May, 1940, U. S. Public Roads Administration, Washington.

eral differences may be seen in the concentration of vehicles on the highways of different states. In some, such as Rhode Island and New Jersey, driving an automobile is strikingly different than in North Dakota and Nevada. In the former states the driver meets crowded conditions on the highways, whereas in the latter states each driver has the road pretty much to himself. In general speed is higher on highways which have relatively little traffic and lower on highways which are congested. Thus, other things being equal, accidents resulting from speed should be more frequent in states with few vehicles per mile of highway than in states with many vehicles per mile of highway.

Where state mileages are large adequate enforcement of traffic regulations and, in particular, of speed laws are difficult. In North Dakota, for example, approximately 175,000 cars are distributed over 110,000 miles of rural roads, whereas in Rhode Island 168,000 cars are distributed over 2,300 miles of such roads. In order to obtain the same number of highway patrolmen per mile of road as Rhode Island, North Dakota would need a patrol nearly fifty times as large and expensive as it now has. Punishing and re-educating erring drivers, as well as apprehending them, is much simpler in a small state the size of Rhode Island than in a large state the size of North Dakota.

Significant differences in the death rate per mile of road in individual states may be seen in the table, page 168. Notice that there is less than one traffic death for each thousand miles of road in North Dakota, whereas in New Jersey there are 36 fatalities for each thousand miles of open road. Also observe that in Tables 42 and 43 practically the same states top and foot each list, showing that highways with large numbers of cars on them have a greater number of accidents than highways with only a small number of cars. But it should also be pointed out that where vehicles are numerous per mile of road, fatality figures do not give a true picture of the total accident situation since the number of minor accidents per mile are undoubtedly proportionately greater.

Effect of Number of Inhabitants per Vehicle. In some states there is a car for every 2 or 3 persons and in others there is a car for only every 10 or 11 persons. The southeastern states have the fewest cars per person and the west and north central states have the most cars per person.

The principal reason why there are so few cars per person among the southeastern states is their small per capita wealth and their high proportion of negro population, which is low in economic status. The high proportion of cars per person in Kansas, Colorado, Wyoming, Arizona, Nevada, Oregon, and Washington, on the other hand, is to be attributed chiefly to poor non-automotive transportation facilities, and to the resultant greater need for automobiles on the part of the predominantly rural

population. The relatively high per capita wealth in California, Michigan, Iowa, Ohio, and Minnesota helps to explain their high per capita automobile registration (see Figure 32).

The low per capita registration of automobiles in states like Massachusetts, Pennsylvania, and New York with high per capita wealth is to be attributed to the influence of urbanization. In cities, the loss of time resulting from congested streets, and from the difficulty in parking, discourages the use of automobiles. Urban families choose their places of residence near main street car, bus, or subway lines so that the breadwinners may commute to work cheaply and quickly without the necessity of

TABLE 43

FATALITIES PER 1,000 MILES OF RURAL HIGHWAY BY STATES (1939)
(Average for United States, 10.9)

Rank of State	Deaths per 1,000 Miles of Highway	Rank of State	Deaths per 1,000 Miles of Highway
1. New Jersey	36.3	25. Maine	8.6
2. Rhode Island	34.4	26. Texas	8.6
3. Connecticut	32.0	27. New Hampshire	8.0
4. New York	29.5	28. Arizona	7.9
5. California	28.4	29. Utah	7.7
6. Massachusetts	27.4	30. Missouri	7.1
7. Florida	24.2	31. Georgia	7.0
8. Pennsylvania	24.0	32. Mississippi	6.9
9. Maryland	23.5	33. Oregon	6.7
10. Ohio	23.0	34. Idaho	6.2
11. Illinois	21.6	35. New Mexico	6.1
12. Delaware	20.4	36. Vermont	6.1
13. Virginia	17.7	37. Arkansas	5.6
14. Michigan	16.5	38. Iowa	5.3
15. North Carolina	15.6	39. Minnesota	5.1
16. Indiana	14.3	40. Oklahoma	5.1
17. South Carolina	12.5	41. Wyoming	5.1
18. Louisiana	12.4	42. Colorado	4.4
19. Kentucky	12.1	43. Nevada	3.3
20. West Virginia	10.5	44. Kansas	3.2
21. Alabama	10.2	45. Nebraska	2.7
22. Washington	9.5	46. Montana	2.2
23. Tennessee	9.5	47. South Dakota	1.2
24. Wisconsin	8.8	48. North Dakota	0.9

Sources: Rural highways: Table "State of Improvement of All Rural Highways," *American Highways,* 19 [1], 8–9 (1939); except New Mexico which was taken from "State Statistics Relating to Roads," National Highway Users Conference.

Fatalities: United States Motor Vehicle Accident Fatalities, 1939, *Vital Statistics—Special Reports,* 11 [51], 547 (January 30, 1941). Bureau of the Census, Washington.

owning a motor vehicle. On week ends and vacations, the availability of convenient mass transportation facilities enables them to reach near-by pleasure resorts.

The relation of population per vehicle to the safety status of a state is not clear. The southeastern states with the lowest proportion of vehicles per person as a group have the worst accident record, but in other regions there is little relationship between vehicles per population and safety

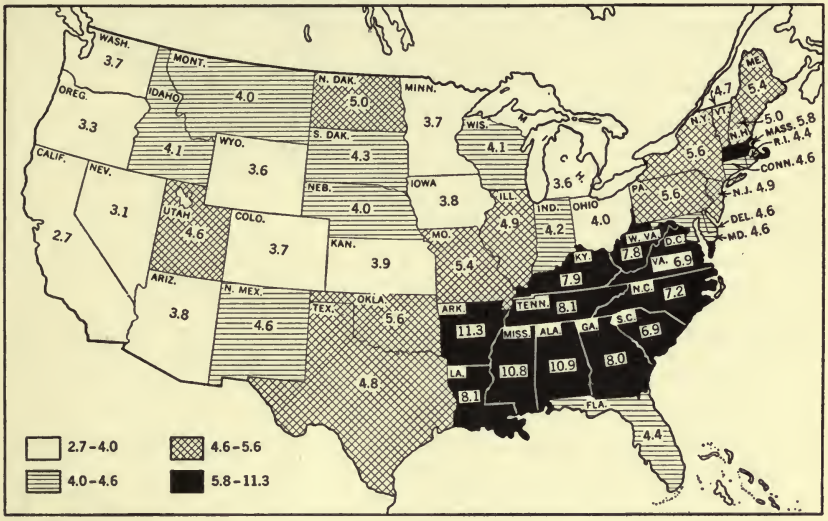


FIG. 32. Population per passenger car by states (1939).

Source: *Automobile Facts and Figures*, 1940, p. 16. Automobile Manufacturers Association, Detroit, Mich.

standing. It would seem therefore that the number of vehicles per person has no important direct effect on accidents.

Effect of Density of Population. That density of population is related to density of highway fatalities is indicated by a comparison of Figures 33 and 34. In Figure 33 the states are divided into four groups according to density of population per square mile. In Figure 34, they are similarly divided according to the number of automobile fatalities per 1,000 square miles of land area.

A comparison of the two maps shows that the distribution of states by fatalities per square mile follows very closely their distribution by density of population. The reason is that where the population in a state is sparse there are fewer cars per mile of road, less congestion during the busy hours of the day and on week ends, a smaller number of pedestrians on the streets and highways, and therefore fewer chances of collisions. It

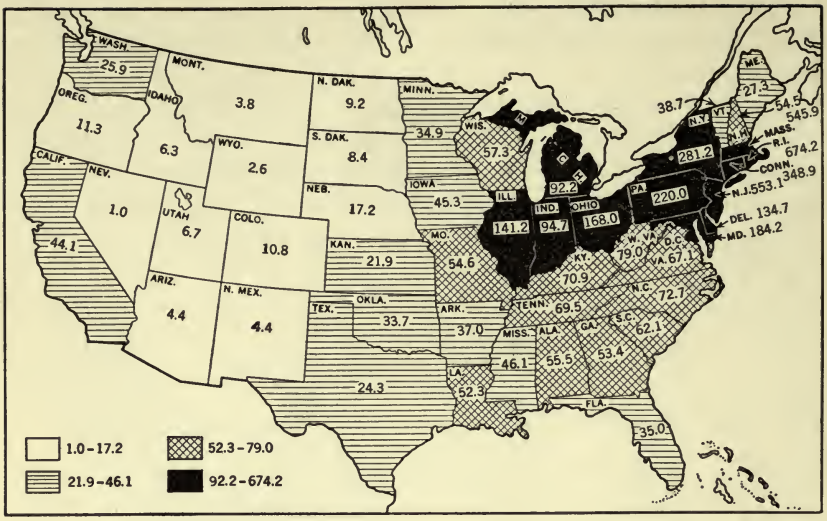


FIG. 33. Density of population per square mile by states (1940).

Source: Population: *Final Population Figures for the United States by States, 1940,* p. 3, Series P-2, 1940. Bureau of the Census, Washington.

Area: *Land and Water Area of the United States by States, 1940,* p. 1. Bureau of the Census, Washington, 1941.

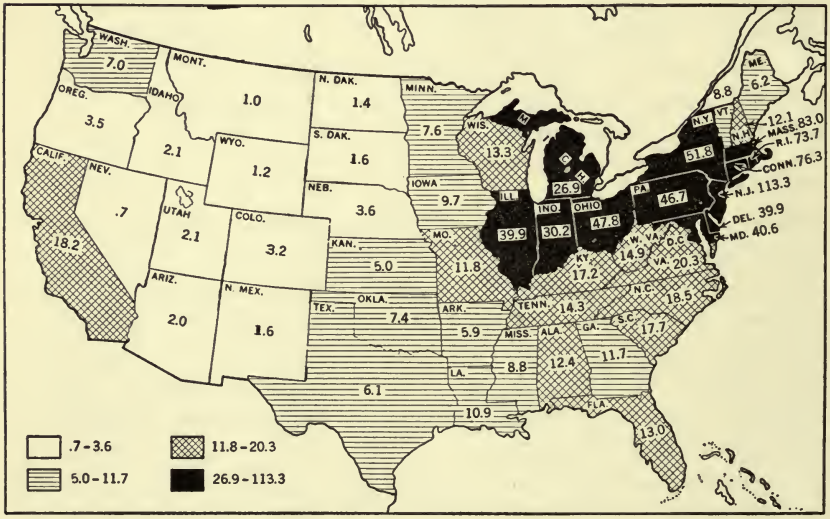


FIG. 34. Motor vehicle fatalities per 1,000 square miles of land area by states (1939).

Source: Motor vehicle fatalities: "United States: Motor Vehicle Accident Fatalities, 1939," *Vital Statistics—Special Reports,* 11 [51], 547 (January 30, 1941). Bureau of the Census, Washington.

Area: *Land and Water Area of the United States by States, 1940,* p. 1. Bureau of the Census, Washington, 1941.

would be unwise though to assume that density of population is the only important factor which influences accidents, for as we shall see next, the most densely populated states have the best standing on a vehicle-mile rating.

Effect of Urbanization. Table 44 shows the comparative ranking of states according to their urbanization and their density of population. It will be noticed that there are wide differences in the ranking of the states in these two respects. Thus there are some states with dense populations and a high degree of urbanization, such as Rhode Island, Massachusetts, New York, and New Jersey. And at the other extreme are states with sparse populations and a low degree of urbanization such as North Dakota, South Dakota, New Mexico, and Idaho. Likewise there are states with a high degree of urbanization and low density of population like California, Utah, Florida, and Washington; states with a low degree of urbanization and a high density of population such as South Carolina, North Carolina, West Virginia, and Kentucky.

A glance at the fatalities-per-vehicle-mile rating of the states shows that the most densely populated highly urbanized states like Rhode Island, Massachusetts, New York, and New Jersey have excellent safety ratings. But so do two of the states with a low degree of urbanization and low density of population—North Dakota and South Dakota. Strangely enough the states representing the extremes of density of population and urbanization are among the safest states, indicating clearly that the influence of density of population and urbanization on safety status is a complex one, and can only be understood in the light of other equally important factors.

Of the states with a high degree of urbanization and low density of population, California, Utah, and Florida have a poorer-than-average standing on a fatality-per-vehicle-mile basis, whereas Washington has a better-than-average standing.

The states with a low degree of urbanization and high density of population such as South Carolina, North Carolina, West Virginia, and Kentucky all have a poor standing on the fatality-per-vehicle-mile basis.

It is clear that urbanization, like density of population, does influence the hazard of driving but its effect is complicated by corresponding differences in density of population. From what has been said above it seems that fatalities per vehicle-mile are low in the densely populated urbanized states, and that fatality-per-vehicle-mile rates are, in general, high in densely populated rural states. Let us now see what effect the factors of urbanization and the density of population have on the safety status of states when they are combined.

Effect of a Combination of Density of Population and Urbanization. In Table 45 the states have been ranked in four groups according to their

TABLE 44

RANKING OF STATES IN URBANIZATION COMPARED WITH RANKING IN DENSITY OF POPULATION AND SAFETY RATING IN FATALITIES PER 100,000,000 VEHICLE-MILES

Ranking in per Cent of Urban Population	Ranking in Density of Population (1940)	Ranking in Fatalities per Vehicle-Mile (1939)	Actual per Cent of Urban Population (1940)	Actual Density of Population per Square Mile (1940)	Fatalities per 100,000,000 Vehicle-Miles, (1939)
1. Rhode Island	1	1	91.6	674.2	4.7
2. Massachusetts	3	2	89.4	545.9	7.3
3. New York	5	15	82.8	281.2	10.6
4. New Jersey	2	3	81.6	553.1	8.0
5. Illinois	9	28.5	73.6	141.2	12.8
6. California	27	28.5	71.0	44.1	13.0
7. Connecticut	4	4	67.8	348.9	8.5
8. Ohio	8	26	66.8	168.0	12.2
9. Pennsylvania	6	23	66.5	220.0	11.4
10. Michigan	12	24	65.7	92.2	11.5
11. Maryland	7	22	59.3	184.2	11.3
12. New Hampshire	22	8	57.6	54.5	9.4
13. Utah	42	31	55.5	6.7	13.8
14.5. Florida	30	37	55.1	35.0	16.0
14.5. Indiana	11	32	55.1	94.7	14.1
16. Wisconsin	19	20.5	53.5	57.3	11.0
17. Washington	34	18.5	53.1	25.9	10.9
18. Colorado	39	28.5	52.6	10.8	12.8
19. Delaware	10	20.5	52.3	134.7	11.0
20. Missouri	21	12.5	51.8	54.6	10.0
21. Minnesota	31	11	49.8	34.9	9.9
22. Oregon	38	25	48.8	11.3	11.9
23. Texas	35	17	45.4	24.3	10.8
24. Iowa	26	5.5	42.7	45.3	8.9
25. Kansas	36	9	41.9	21.9	9.5
26. Louisiana	24	38	41.5	52.3	16.2
27. Maine	33	14	40.5	27.3	10.4
28. Nevada	48	41.5	39.3	1.0	16.9
29. Nebraska	37	12.5	39.1	17.2	10.0
30. Montana	46	18.5	37.8	3.8	10.9
31. Oklahoma	32	16	37.6	33.7	10.7
32. Wyoming	47	35	37.3	2.6	15.4
33. Virginia	17	43	35.3	67.1	17.0
34. Tennessee	16	44	35.2	69.5	17.2
35. Arizona	44.5	45	34.8	4.4	18.5
36. Georgia	23	36	34.4	53.4	15.5
37. Vermont	28	10	34.3	38.7	9.6
38. Idaho	43	34	33.7	6.3	14.7
39. New Mexico	44.5	39	33.2	4.4	16.7
40. Alabama	20	48	30.2	55.5	21.0
41. Kentucky	15	46	29.8	70.9	19.8
42. West Virginia	13	28.5	28.1	79.0	13.0
43. North Carolina	14	41.5	27.3	72.7	16.9
44. South Dakota	41	5.5	24.6	8.4	8.9
45. South Carolina	18	47	24.5	62.1	20.9
46. Arkansas	29	33	22.2	37.0	14.2
47. North Dakota	40	7	20.6	9.2	9.2
48. Mississippi	25	40	19.8	46.1	16.8

Sources: Density of Population, Bureau of the Census, 1941.
Density of population per square mile, Bureau of the Census, 1941.
Per cent of urban population, Bureau of the Census, 1941.
Fatalities per vehicle-mile, Bureau of the Census—Vital Statistics, and U. S. Public Roads Administration.

TABLE 45

RANKING OF STATES ACCORDING TO COMBINED DENSITY OF POPULATION AND PER CENT OF URBAN POPULATION CONTRASTED WITH RANKING ACCORDING TO FATALITIES PER 100,000,000 VEHICLE-MILES (1939)

(U. S. average, 12.0 fatalities per 100,000,000 vehicle-miles)

Combined Ranking by per Cent of Urbanization and Density of Population		Fatalities per 100,000,000 Vehicle-Miles	Combined Ranking by per Cent of Urbanization and Density of Population		Fatalities per 100,000,000 Vehicle-Miles
Group I			*Group* III		
1.	Rhode Island	4.7	24.5.	Utah	13.8
2.	Massachusetts	7.3	26.	Kentucky	19.8
3.	New Jersey	8.0	27.5.	Colorado	12.8
4.	New York	10.6	27.5.	North Carolina	16.9
5.	Connecticut	8.5	29.	Texas	10.8
6.	Illinois	12.8	30.	Georgia	15.5
7.	Pennsylvania	11.4	32.	Oregon	11.9
8.	Ohio	12.2	32.	Maine	10.4
9.	Maryland	11.3	32.	Alabama	21.0
10.	Michigan	11.5	34.	Kansas	9.5
11.	Indiana	14.1	35.5.	Oklahoma	10.7
12.	Delaware	11.0	35.5.	South Carolina	20.9
	Group average	10.3		Group average	14.5
Group II			*Group* IV		
13.	California	13.0	37.	Vermont	9.6
14.	New Hampshire	9.4	38.	Nebraska	10.0
15.	Wisconsin	11.0	39.	Mississippi	16.8
16.	Missouri	10.0	40.	Arkansas	14.2
17.	Florida	16.0	41.5.	Montana	10.9
19.5.	Iowa	18.9	41.5.	Nevada	16.9
19.5.	Virginia	17.0	43.	Wyoming	15.4
19.5.	Tennessee	17.2	44.	Arizona	18.5
19.5.	Louisiana	16.2	45.	Idaho	14.7
22.	Washington	10.9	46.	New Mexico	16.7
23.	Minnesota	9.9	47.	South Dakota	8.9
24.5	West Virginia	13.0	48.	North Dakota	9.2
	Group average	12.7		Group average	13.5

Source: Per cent of urbanization and density of population from Bureau of the Census, 1941.
Fatalities per vehicle-mile, 1939, from Bureau of the Census—Vital Statistics, and U. S. Public Roads Administration.

standing in both urbanization and density of population (the respective rankings of states by urbanization and by density of population were given equal weight in arriving at their combined rankings), and according to

fatalities per vehicle-mile. Note that the densely urbanized states in Group I have a better-than-average fatality record—10.3 as compared with 12.0 for all states. Group II, the next 12 states ranked on the combined basis, have the same average as for the country as a whole, whereas both Groups III and IV have averages worse than that for all states. But although the densely urbanized states show a superior fatality-per-vehicle-mile rating, an examination of the safety ratings of individual states shows little correlation with their combined urbanization and density of population standings.

An important factor that has contributed to the better standing of the urbanized densely populated states is the improvement in urban fatality rates as compared with rural fatality rates. As to how much the urban reduction can be ascribed to urban conditions themselves and how much to more efficient safety activities in cities is a question that cannot be answered until specific investigations are directed at this subject. Unquestionably, however, moderate driving speeds in urban districts contribute to a low fatality rate, whereas high driving speeds in rural sparsely settled districts favor a high fatality rate.

Effect on State Safety of Hazards Arising from the Roadway. The two other most important types of hazards which affect the safety status of states are those arising from the roadway and those arising from climatic conditions. It is difficult to separate the effects of these two different factors.

As to information on comparable differences in the safety of the engineering and design features of the highways in states we have at present little or no information, although the U. S. Public Roads Administration is starting to assemble data of this sort which should enable us within a few years to compare the highways in the different states in terms of their relative potential safety. [123] Differences in widths of pavement, degree of curvature, per cent of grades, sight distances, etc., all bear a part in determining the relative ease and safety with which one may drive over a road (see Chapter XII).

In an article dealing with regional differences in our highway system H. E. Hilts, Chief of the Division of Highway Transport, of the Public Roads Administration, states that "in general, routes in the southern part of the country are more dangerous than northern routes [123, *80*], but he gives no inkling as to why travel over southern highways should be more hazardous.

One of the best proofs that driving in the southern part of our country is more dangerous than in the northern part is to be seen in the accompanying figure showing the differences in fatality rates per vehicle-mile

in the 24 more northerly states as compared to the fatality rate in the 24 more southerly states. Note that the average rate of the southern states is 15.6 fatalities per 100 million vehicle-miles as against 10.5 for the northern group of states. Note also that a vertical comparison of the respective rates of states at various locations from east to west shows a general tendency to increase from north to south.

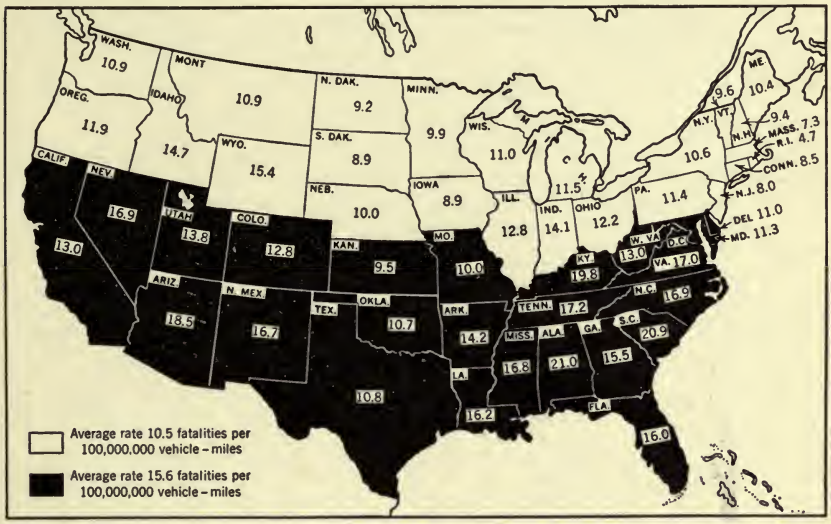


FIG. 35. Motor vehicle fatalities per 100,000,000 vehicle-miles in the more northerly twenty-four states as compared to the more southerly twenty-four states (1939).

Source: Fatalities: "United States: Motor Vehicle Accident Fatalities, 1939," *Vital Statistics—Special Reports*, 11 [51], 547 (January 30, 1941). Bureau of the Census, Washington.

Vehicle-miles: Adapted from gasoline consumption data in "Analysis of Motor-Fuel Usage in Calendar Year 1939," Table G-21, 1939, issued November, 1940. U. S. Public Roads Administration, Washington.

The percentages of fatalities, gasoline consumption, registrations and population of these northern and southern groups of states are shown in Table 46.

Although the percentage of registrations and of total gasoline consumption * is about the same in the south as in the north, the percentage of fatalities is much greater in the former. On a population basis the southern states also rank below the northern states.

* The mild climate in the south encourages motorists to use their cars more during the entire year than in the north. But other factors tend to restrict gasoline consumption in the south, such as the lower economic status of the population, and the larger proportion of rural drivers with their lower annual mileages.

TABLE 46

COMPARISON OF TWENTY-FOUR SOUTHERLY STATES WITH TWENTY-FOUR NORTHERLY STATES IN PER CENT OF FATALITIES, GASOLINE CONSUMPTION, REGISTRATIONS, AND POPULATION (1939)

	Twenty-Four Southerly States	Twenty-Four Northerly States
Automobile fatalities	45.8	54.2
Gasoline consumption	39.6	60.4
Vehicle registrations	39.5	60.5
Population	42.7	57.3

Source: Same as that for Table 37, Chapter VII.

TABLE 47

MILES OF HIGH-TYPE-SURFACE HIGHWAY PER 100,000 VEHICLES IN TWENTY-FOUR SOUTHERLY STATES COMPARED WITH THOSE OF TWENTY-FOUR NORTHERLY STATES (1933)

(Average for United States, 495)

Twenty-Four Southerly States	Miles of High-Type Surface per 100,000 Vehicles	Twenty-Four Northerly States	Miles of High-Type Surface per 100,000 Vehicles
Delaware	1,706	Vermont	769
South Carolina	1,467	Oregon	672
Arkansas	1,066	Iowa	665
North Carolina	1,005	Wisconsin	658
Louisiana	943	Illinois	654
Texas	940	Indiana	570
West Virginia	859	New York	497
Tennessee	788	New Hampshire	419
Maryland	638	Ohio	419
Georgia	601	Pennsylvania	387
Alabama	564	Michigan	377
Missouri	538	Rhode Island	375
Florida	524	Minnesota	370
Kentucky	506	Connecticut	307
Oklahoma	450	Maine	287
Virginia	448	Washington	253
Mississippi	407	Massachusetts	202
Arizona	266	Idaho	193
Kansas	261	New Jersey	191
Utah	260	Nebraska	181
California	254	South Dakota	111
Nevada	246	Wyoming	66
Colorado	185	Montana	41
New Mexico	151	North Dakota	20
Average	628	Average	362

Source: H. W. Breakey, *Trends and Seasonal Variation in Factors Influencing Domestic Motor-Fuel Demand*, pp. 47, 48. Bureau of Mines, Washington, 1940.

The only roadway factor which we can think of that might help to explain this difference between northern and southern states is the greater proportion of high-type-surface highways per vehicle in the southern states. Note in the table on page 176 that the proportion of high-type-surface highways per vehicle in the southern states averages 628 miles as compared with 362 miles per vehicle in the north. Better highways make for faster speeds especially when they are not crowded and, in

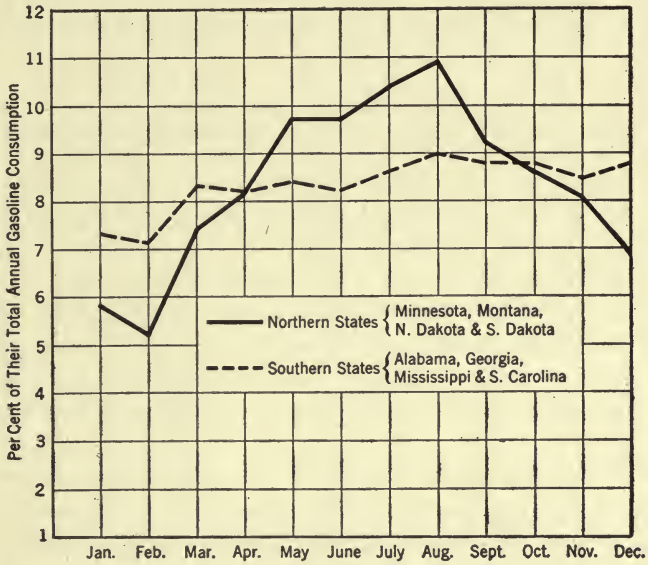


FIG. 36. Gasoline consumption on highways of four northern states compared with that in four southern states by months (1939).

Source: "Analysis of Motor-Fuel Usage in Calendar Year 1939," Table G-21, 1939, issued November, 1940. U. S. Public Roads Administration, Washington.

turn, for more fatalities. The fine hard-surfaced highways and the mild winter climate (encouraging more pleasure driving), of which the south is so proud, undoubtedly contribute to its high fatality rate.

Effect on State Safety of Hazards Arising from Climatic Conditions. Differences in climate between the north and the south influence the time when cars are used. Motor vehicles are driven considerably more throughout the late fall and winter in the south than in the north. The accompanying figure illustrates these differences between four of the most southerly as compared with four of the most northerly states. Note that the gasoline consumption is fairly even throughout the year in the southern states, with the exception of a relatively small decline in January and February, whereas gasoline consumption is very high from May to

August in the northern states and runs about fifty per cent as much in January and February.

Since winter driving is more dangerous (see Figure 5) and the southern driver travels more during these months of short days under conditions of poor visibility he is naturally more subject to accidents than the northerner. Undoubtedly the more changeable weather and the necessity of driving more on icy roads impress caution on the northern driver during winter months. Since he is subjected more often to slippery roads he learns to adjust his driving better to suit changeable road and climatic conditions.

The Influence Differences in Driving Speed Have on Safety Status

There are no data on regional differences in driving speeds. It will therefore be necessary to estimate differences of speeds indirectly by noting variations in the number of that type of accident which results most often from high speed, namely, non-collision fatalities such as running off the road or turning over.* Note in the accompanying table that states in the northeast and east north central regions have the fewest non-collision-type fatal accidents. The fact that traffic is known to be heaviest in these states is another reason for believing that speeds are lowest there.

The highest proportion of non-collision accidents occurs in the Mountain States, where the most dangerous grades and curves encountered in mountain driving add to the danger of the higher speed evidently current there.

There is comparatively little difference in the non-collision fatality rates in the rest of the country from which one might assume that speeds are generally higher outside of the northeast and east north central regions.

Speed is a more important determinant of accidents on rural highways than on city streets as is shown by Table 49 on page 180. Thus in Michigan cities and villages the most common reported † speed of drivers in all accidents was between 10 and 19 miles per hour, whereas on rural trunk line highways the most frequently reported speed was between 30 and 39 miles per hour. The higher reported speeds for fatal accidents as compared with non-fatal and property damage accidents on city streets and main rural highways indicate the part played by higher speeds in

* Of course, non-collision fatalities may occur from other factors such as fatigue, but it is generally accepted that speed is the most important factor in non-collision fatalities.

† It is ordinarily agreed that the average driver reports the speed at which he was traveling at the time of an accident as at least 10 miles below his actual speed.

TABLE 48

PER CENT OF NON-COLLISION FATALITIES BY REGIONS (1940)

Northeast	Average 8.1
Rhode Island	0.0
Massachusetts	4.5
New Jersey	5.2
Connecticut	6.0 [1]
Pennsylvania	7.5
New York	8.4
Maine	11.5
New Hampshire	14.9
Vermont	15.5
East North Central	Average 10.6
Illinois	7.6
Michigan	11.7
Indiana	12.7
West North Central	Average 24.2
Iowa	20.4
Kansas	23.2
Nebraska	29.2
South Atlantic	Average 25.9
North Carolina	24.4
Virginia	25.1
South Carolina	28.4
East South Central	Average 23.4
Kentucky	21.3
Tennessee	25.5
West South Central	Average 23.6
Louisiana	14.5 [2]
Texas	22.5
Oklahoma	26.8
Arkansas	30.7
Mountain	Average 36.1
Colorado	21.8
Idaho	30.6
Utah	32.1
Nevada	46.4 [1]
Arizona	50.0
Pacific	Average 20.4
California	15.5
Oregon	25.3

1 Per cent fatal accidents.
2 The unusually low rate is possibly to be attributed to poor accident reporting.

Source: Annual statistical reports for these states for 1940.

TABLE 49

PERCENTAGE DISTRIBUTION OF ACCIDENTS BY APPROXIMATE SPEEDS OF VEHICLES INVOLVED, SEGREGATED BY TYPE OF ACCIDENT AND ROAD AND STREET SYSTEM
(Michigan, 1939)

Speed Range	Cities and Villages				Rural Trunk Line				Rural County Road			
	Fatal	Non-fatal	Property damage	Total	Fatal	Non-fatal	Property damage	Total	Fatal	Non-fatal	Property damage	Total
Standing still	4.8	10.1	22.1	19.9	4.8	5.8	8.3	7.2	5.1	6.0	10.1	8.1
Under 10 m.p.h.	5.1	13.6	19.7	18.5	3.0	4.4	5.9	5.3	2.9	5.0	6.2	5.5
10 to 19 m.p.h.	18.7	33.9	36.5	35.7	3.6	8.4	11.1	9.8	7.2	10.4	14.9	12.6
20 to 29 m.p.h.	40.8	27.9	16.2	18.5	10.6	14.5	15.1	14.7	17.4	24.3	23.6	23.5
30 to 39 m.p.h.	18.3	9.3	3.9	5.1	23.2	24.4	23.7	23.9	29.3	25.9	24.7	25.6
40 to 49 m.p.h.	7.3	3.4	1.2	1.6	25.9	22.5	21.9	22.3	23.1	18.9	14.4	16.7
50 and over m.p.h.	5.0	1.8	0.4	0.7	28.9	20.0	14.0	16.8	15.0	9.5	6.1	8.0
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Source: *Federal Regulation of the Sizes and Weight of Motor Vehicles,* House Document 354, p. 492. Transmitted by Interstate Commerce Commission. Washington: U. S. Government Printing Office, 1941.

the consequences of accidents. Note that on main rural highways the most common reported speed of drivers in fatal accidents is over 50 miles per hour, as compared with 30 to 39 miles per hour for non-fatal and property damage accidents.

Another indication of variations in speed of driving is in the different speed limits in force. Thus Table 22 in Chapter III shows legal speed limits to be highest in the west, somewhat lower in the south, and lowest of all in the northeast.

Several reasons help to explain the lower speeds in the northeast. One is the heavier traffic, which tends to limit the speed. Another is the large number of highway patrolmen, which results in more rigid enforcement of the prevailing speed laws. A third factor is the proximity of cities which, by shortening the average daily trip, induces lower speeds.

The apparent higher speed of driving in the south and west undoubtedly contributes to the relatively high fatality rates per vehicle-mile in those sections as compared with the rates in the northeast. It is well to remind ourselves, however, that other factors influence regional differences in fatality-per-vehicle-mile rates in addition to speed.

The Influence That the Type of Driver Has on Safety Standing

There are, unfortunately, no data on variations between drivers—their relative skill and safety-mindedness—in different states, but one way we can obtain indirect information about such differences is from comparisons of the economic, educational, and crime prevention status of the states. Another way is to study the proportions of non-owner-drivers, out-of-state drivers, urban and rural drivers, and pleasure and business drivers.

Effect of Drivers' Economic Status. States with low average income levels tend to be handicapped in accident prevention because their public officials have less money available to spend on driver control and education than states with higher income levels. In states where money for governmental purposes is scarce, as in the southeast, there is less opportunity to build up strong state motor vehicle and police departments to cope with the accident problem.

In addition, as was pointed out in Chapter V persons of low economic status tend to become involved in a higher than normal number of accidents. The sizeable negro population in the southeast, which forms a large low economic group, unquestionably contributes to the higher fatality rate in this region. To reduce their accident rates the southern states must make strenuous efforts to improve both the driving and the walking habits of their negro citizens.

Effect of Drivers' Educational Status. One of the aims of education is to mould the development of the individual so that he will become a good citizen. It would be strange, therefore, if education would not also help to decrease automobile accidents.

One indication of adequate education facilities is the literacy of the population. In the United States illiteracy is confined principally to the south and to a less extent to our eastern and western coasts. [50, *53*]

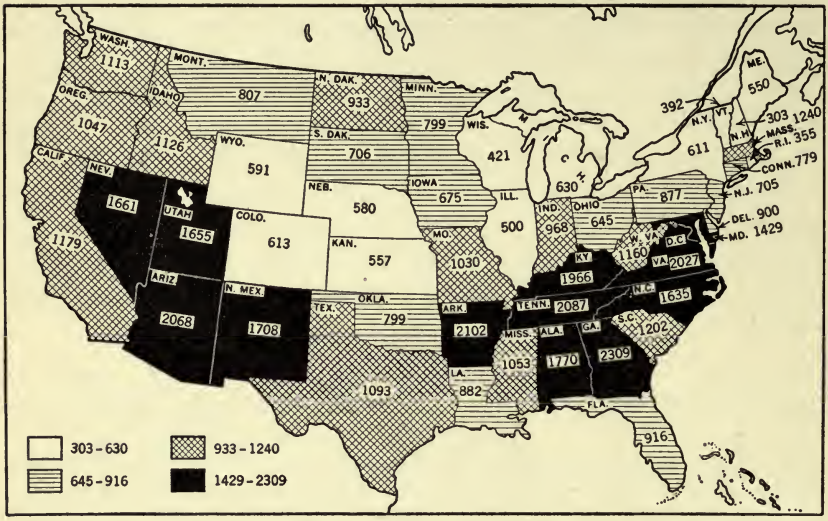


Fig. 37. Automobile thefts per 100,000 passenger cars by states (1938).
Source: "Automobile Thefts per Population," *Uniform Crime Reports,* 9 [4], 136 (1938). Federal Bureau of Investigation.
Persons per vehicle: *Automobile Facts and Figures,* p. 20, 1939.

The presence of considerable numbers of illiterates handicaps a state in securing results from printed educational material.*

Another gauge of educational facilities is the amount expended on education per capita. This is, in general, lower in the southeast and south central regions than in other parts of the country. [50, *111*]

Both these factors contribute to the higher accident rate in the southern states. Further, safety educational work in the schools, which has been instrumental in markedly reducing the death rate of child pedestrians, is hampered in states where the elementary schools are not adequately supported. Accident prevention programs flourish best in schools with well-paid and well-trained teachers.

* Results from Army intelligence testing in the past war revealed more illiterates, and also lower average scores on the tests among both white and colored draftees from the southern states. [299]

Effect of Prevalence of Crime. The presence of a large number of criminally inclined persons does not make for a low accident rate. Certain southeastern states lead in crimes involving aggravated assault. [100, *136*] Another indication of the prevalence of misdirected tendencies more closely connected with the automobile accident situation is the automobile theft rate. In Figure 37 we see that the stolen car rate is high in the south. The large number of automobile thefts is an indication of a low degree of social responsibility in certain sections of the population, and also of a poorer degree of police enforcement, both of which are conducive to a high automobile accident rate.

The states in the southeast in reducing their automobile accident rates face a serious problem of disciplining a large number of their drivers and pedestrians, who for a combination of reasons drive and walk less safely than they should.

Effect of Proportion of Non-Owner-Drivers. In some states the proportion of non-owner-drivers is higher than in other states. Table 50

TABLE 50

STATE RATIOS OF LICENSED DRIVERS TO REGISTERED VEHICLES

State	Ratio of Drivers to Vehicles
South Carolina	1.78
Alabama	1.73
Texas	1.53
Mississippi	1.53
Georgia	1.51
New Mexico	1.46
Ohio	1.40
New York	1.38
Indiana	1.35
Utah	1.35
Montana	1.34
Massachusetts	1.33
Delaware	1.33
Virginia	1.32
Arkansas	1.31
Maine	1.30
New Hampshire	1.26
Oregon	1.23
New Jersey	1.23
Vermont	1.23
Rhode Island	1.22
Pennsylvania	1.19
Connecticut	1.16

Source: Based on questionnaires to various states and published statistical reports of other states for recent years.

shows how the ratio of drivers to registered vehicles varies in different states where this information is available.

Normally a higher ratio of drivers to registered vehicles can be taken to mean a higher proportion of non-owner-drivers. The states with the largest number of drivers per vehicle are in the south, whereas the states with the fewest drivers per vehicle are in the north. The reasons for more drivers per vehicle in the southeast are fewer vehicles per population, lower driver license fees, and easier examinations which encourage the acquisition of licenses. Since non-owner-drivers seem to have a higher accident rate than owner-drivers (see Chapter V, p. 97) the larger proportion of non-owner-drivers in the southeastern states may help to explain the poorer fatality-per-vehicle-mile rate in those states.

Effect of Proportion of Out-of-State Drivers. Certain states of small population which have popular highways connecting centers of population in neighboring states, or which are crossed by busy transcontinental routes, are likely to have higher-than-average volumes of out-of-state traffic. Thus out-of-state vehicles account for a considerable proportion of the total vehicular travel in sparsely inhabited states like Nevada and Wyoming,* whereas in densely populated states like Connecticut and New Jersey foreign vehicles contribute a much smaller share of the total mileage.

Other factors also influence the proportion of out-of-state vehicular travel. Thus states with recreational resorts like Florida, and large cities like New York, act as magnets to attract motorists. Such variations in the percentage of travel by out-of-state vehicles naturally influence the total number of fatalities, fatalities per population, and fatalities per registered vehicle. The proportion of foreign vehicles has less effect on the fatality-per-vehicle-mile rate since it is probable that foreign vehicles on the average purchase enough gasoline in the state traversed to offset the mileage traveled.

Effect of the Proportion of Urban and Rural Drivers. Many factors need to be considered in comparing the accident rate of urban and rural drivers. Thus urban drivers travel more miles per year than rural drivers, subjecting them to more chances of collisions. Urban motorists own more new model vehicles which presumably they drive faster than rural dwellers do their older vehicles. Urban motorists use their cars more for pleasure, whereas rural operators travel more out of necessity. Urban dwellers travel more at night, on week ends and take more pleasure

* U. S. Public Roads Administration figures show that out-of-state registered vehicles in Nevada constitute 48.7 per cent, and in Wyoming 39.8 per cent of all traffic on the state primary road system.

trips out of their home state than inhabitants of rural sections, and urban operators are subjected to more dangerous exposure than rural motorists because of the presence of large numbers of vehicles and pedestrians, and because of hazardous intersections in the vicinity of their homes.

It would seem therefore that urban motorists are unquestionably subject to greater risks of incurring non-fatal accidents. Thus a state with a high per cent of urban car owners normally will have more non-fatal and property damage accidents than a state with a low per cent of urban car owners. But until further facts are available we must attribute the higher accident rate of urban drivers to the differences in exposure to which urban and rural drivers are subjected, rather than to differences between the urban and rural drivers themselves.

Effect of the Proportion of Pleasure and Business Drivers. Table 51 shows that necessity mileage is higher in rural areas and lower in

TABLE 51

PERCENTAGE OF NECESSITY MILEAGE OF TOTAL MILEAGE OF DRIVERS IN VARIOUS POPULATION GROUPS

(Thirty-one states)

Population Group of Place of Ownership	Necessity Mileage per Cent of Total Mileage
Unincorporated areas	65.6
Incorporated areas with population of	
Less than 1,000	59.2
1,000 to 2,500	56.1
2,500 to 5,000	53.8
5,000 to 10,000	53.0
10,000 to 25,000	51.5
25,000 to 100,000	51.6
100,000 and over	51.5
All areas (31 states)	56.7

Source: Summarized from U. S. Public Roads Administration figures in *A Factual Survey of Automobile Usage,* p. 14. Automobile Manufacturers Association, Detroit, Michigan.

large communities. If necessity driving is less dangerous than pleasure driving (see Table 4) then the higher proportion of necessity travel in rural states with few large cities would tend to improve the accident standing of these states as compared with more highly urbanized states. The all-year-round pleasure driving in the south might, for example, help to explain its higher accident rate, but it is useless to theorize further until we have learned more about the relative danger of necessity and non-necessity travel, and why one is more dangerous than the other.

The Influence of the Vehicle, Its Use, Age, and Condition on Safety Status

The fifth factor we shall discuss which influences the safety status of states is the vehicle. The comparative use of the available vehicles, their average age, and their condition all affect the accident rate of a state.

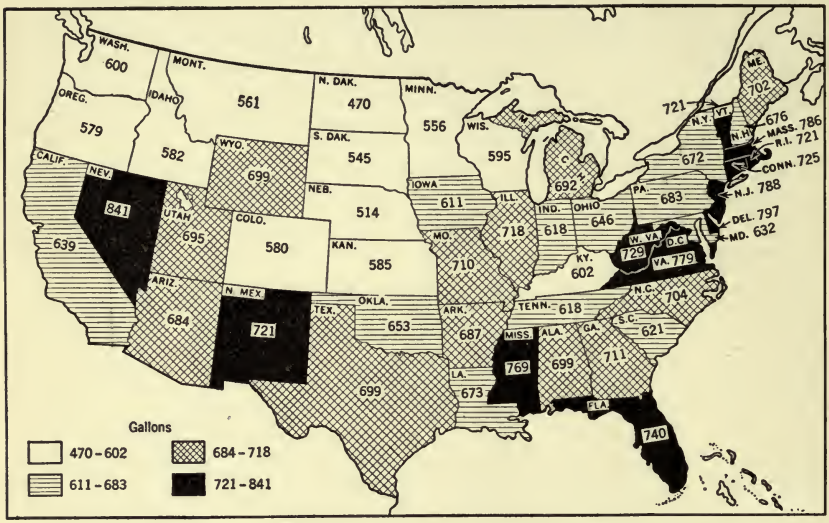


Fig. 38. Gasoline consumption per motor vehicle by states (1939).

Source: Gasoline consumption: "Analysis of Motor-Fuel Usage in Calendar Year 1939," Table G-21, 1939, issued November, 1940. U. S. Public Roads Administration, Washington.

Motor vehicle registrations: "State Motor Vehicle Registrations, 1939," Table MV-1, 1939, issued May, 1940. U. S. Public Roads Administration, Washington.

Effect of the Use of the Vehicle. A fairly reliable measure of the use of vehicles is the annual amount of gasoline consumed. Vehicle usage varies considerably from state to state as can be seen from Figure 38.

In the north central and northwestern states the severe winter weather, high mileage of poor roads and lack of snow removal, the latter two partly attributable to insufficiency of funds, cause sharp reductions in gasoline consumption and motor vehicle travel during the winter months. In the northeastern states on the other hand, where there is a more concentrated mileage of good roads, where the weather is milder, and more money is spent on snow removal, a larger proportion of car owners can

continue to drive throughout the winter, thus maintaining a high level of gasoline consumption.

Another factor influencing the annual mileage of motor vehicles is urbanization. Highway Planning Surveys show that urban gasoline consumption per vehicle is greater than rural consumption per vehicle. [169, *48*] One reason for the higher gasoline consumption of city motorists is the larger amount of stop-and-go driving. For example, an investigation in Massachusetts indicates that in heavy city traffic the average mileage obtained from a gallon of gasoline is around 10.5 miles as compared to 18 miles per gallon on the open highway where there are no traffic delays. [40, *106*] Other reasons for urban motorists consuming more gasoline is their higher economic status and their habit of taking longer pleasure trips. [222, *54*]

The high gasoline consumption in Nevada, New Mexico, and Arizona is probably to be accounted for by a combination of two factors: heavy out-of-state travel, and a relatively mild climate, which encourage all-year-round travel.

Other things being equal we should expect that states with high gasoline consumption ought to have more travel per vehicle and therefore more accidents. A comparison of Figure 38 of this chapter with Figure 31 of Chapter VII shows that the southeastern states together with Nevada and New Mexico with an average high gasoline consumption per vehicle also have poor accident records, but conversely the New England and North Atlantic states with high gasoline consumption per vehicle have an excellent fatality per vehicle mile standing. Obviously other factors such as the excellent safety activities in the latter states have contributed to their low accident rates.

Effect of the Age of the Vehicle. The age of the vehicle seems to be a factor in determining how far it is driven annually. According to Table 52 motor vehicles are driven fewer miles as they grow older. Thus after five years their annual mileage is down approximately 25 per cent, and after nine years it is down 50 per cent. Note also that as cars near the end of their operating life they are used more for necessity purposes and are taken out fewer times during the year.

It would seem probable that persons who have to make extensive use of motor vehicles are keener about acquiring the latest model, and that the prestige of owning a late model vehicle encourages one to use it more frequently. Conversely, the likelihood that an aged vehicle may break down on the way, plus its unprepossessing appearance, deters its owner from taking it out except when necessary.

As to whether the age of a vehicle influences the accident susceptibility of its driver we are at present ignorant. But it seems reasonable to

TABLE 52

VARIATION WITH AGE OF VEHICLE OF TOTAL ANNUAL MILEAGE, NECESSITY MILES, AND NUMBER OF ROUND TRIPS

(Six states: Connecticut, Georgia, Indiana, Michigan, Nebraska, Oregon, 1936–1938)

Age of Car	Average Annual Mileage	Necessity Miles	Average Number of Round Trips
Years		*Per cent*	
1	10,768	54.7	619
2	9,628	54.7	620
3	8,592	54.2	593
4	8,106	53.5	604
5	7,624	52.8	545
6	7,083	53.0	524
7	6,718	53.9	496
8	5,804	56.6	468
9 and over	4,770	61.2	417

Source: *A Factual Survey of Automobile Usage*, p. 23. Automobile Manufacturers Association, Detroit, Mich.

assume that drivers with old cars neglect them more and more. The result is that as they age they become less safe to drive. Since they are unable to travel so fast as new cars, old cars are driven more slowly. Hence they are less subject than new vehicles to the risks of high-speed driving, and not traveling so far, old vehicles, of course, encounter fewer hazards.

But the existing evidence on the relative accident susceptibility of new versus old cars is conflicting. In one study made in Connecticut old cars in proportion to their number had a distinctly safer record than new cars [76, *100*], whereas in a study in Washington old cars had a slightly poorer record than new cars on a fatality-per-vehicle-mile basis. [111, *17*] Clearly this subject deserves further study.

Effect of the Condition of the Vehicle. We have few data on the effect of maintenance of vehicles on the safety status of states. New Jersey reported a marked drop in its fatality-per-vehicle-mile rate when its state system of compulsory vehicle inspection was first introduced, but since many other safety activities were being carried on at the same time, one cannot be sure how much of this reduction can be ascribed primarily to the effect of improved maintenance of vehicles. Undoubtedly compulsory vehicle inspection does contribute to the safety status of a state, but how and to what extent, we do not yet know.

Of the 22 states which have some form of periodic inspection of vehicles—Colorado, Connecticut, Delaware, Illinois, Iowa, Maine, Maryland, Massachusetts, Minnesota, Mississippi, New Hampshire, New Jersey, New Mexico, Oregon, Pennsylvania, South Carolina, Tennessee, Texas, Utah, Vermont, Virginia, and Washington—some have excellent fatality-per-vehicle-mile rates and others do not.

THE SAFETY STATUS OF GROUPS OF STATES WITH VARYING SAFETY STANDINGS VIEWED IN THE LIGHT OF THE FACTORS INFLUENCING SAFETY STATUS

In Chapter VII it was pointed out that the fatality-per-vehicle-mile index is the best simple measure of the safety status of states available at the present time. The preceding sections of this chapter have discussed how it is desirable to supplement this fatality-per-vehicle-mile index with other types of information. Let us now test the usefulness of these other gauges of safety status by applying them to states with varying safety status as measured by the fatality-per-vehicle-mile index.

To obtain a better idea of the relative safety standings of different states let us survey their present standings and their relative improvement over a fifteen-year period.

In column 1 of Table 53 the states are rated according to a combination of present status (ranking 1935–1939) and relative improvement (comparative ranking 1935–1939 with ranking 1926–1930). Column 2 shows the average vehicle-mile death rate figures for the period 1926–1930; column 3 shows these for the period 1931–1934; and column 4 for the period 1935–1939. In column 5 the states are ranked according to their standing in 1935–1939.

An inspection of the table reveals that a number of states which were poor in safety a decade ago have improved considerably; that some states which had an excellent standing a decade ago still have a good standing; and that a group of states which had a poor rating a decade ago have not improved since.

To facilitate a comparison of six representative states from each of the above-mentioned groups we have brought them together in Table 54.

Note first of all that the six states with the best present standing and greatest improvement are all in the northeastern part of the country; that the six states with high standing at present and little or no improvement are in the north central part; and that the six states with lowest present standing and considerable increase in fatality rate since 1926 are in the southeastern part of the country. Let us now discuss the reasons for the variations in safety status of these three groups of states.

TABLE 53

Safety Standing of States According to Present Status and Relative Improvement

Standing of States by Combined 1935–1939 Status and Improvement 1935–1939 over 1926–1930	Fatalities per 100,000,000 Vehicle-Miles			Safety Ranking of States
Column 1	Column 2	Column 3	Column 4	Column 5
	1926–1930	1931–1934	1935–1939	1935–1939
1. Rhode Island	17.4	8.6	6.8	1
2. Connecticut	19.0	14.9	10.8	5.5
3. Massachusetts	13.8	12.1	9.6	2
4. New Jersey	19.9	16.8	11.6	8
5. Delaware	21.2	17.6	12.9	14
6. New York	18.3	15.8	12.8	13
7.5. Pennsylvania [1]	22.8	18.8	14.1	21
7.5. New Hampshire [1]	14.3	13.2	12.2	12
9.5. Maryland [1]	21.6	19.4	14.6	23
9.5. Iowa [1]	10.8	12.8	10.3	4
11. Montana	16.3	17.2	13.7	18.5
12. Maine	13.4	13.7	12.0	10
13. Vermont	15.0	13.7	13.0	15.5
14.5. Minnesota [1]	12.6	13.4	11.9	9
14.5. South Dakota [1]	10.3 [2]	11.3	10.2	3
16. Missouri	14.6	14.5	13.0	15.5
17. Illinois	19.0	18.2	15.3	26
19. Michigan [1]	17.7	15.6	15.0	25
19. Ohio [1]	19.0	18.6	15.9	28
19. Wisconsin [1]	14.6	14.2	13.1	17
21. Washington	16.0	16.7	14.2	22
22. Nebraska	10.8	11.7	11.4	7
23. Wyoming	19.0	20.1	16.4	29
24. North Dakota	10.0	12.0	10.8	5.5
25. West Virginia	22.9	23.4	19.3	35
26. Indiana	20.3	20.8	17.9	31
27. Oregon	13.5	15.3	13.7	18.5
28. California	15.4	16.0	14.9	24
29. Kansas	11.1	14.2	12.1	11
30. New Mexico	19.9 [3]	18.0	18.9	33
31. Colorado	14.9	17.7	15.6	27
32. Nevada	19.5 [3]	25.8	19.2	34
33. Arizona	23.4	27.6	21.6	42
34. Utah	20.3	21.9	19.7	38
35. Oklahoma	11.8 [3]	15.4	13.8	20
36. Florida	17.6	21.4	18.6	32
37. Virginia	19.6	22.7	19.8	39
38. Idaho	16.1	17.6	17.8	30
39. North Carolina	19.8	23.0	20.9	40
40. Kentucky	23.4	26.4	23.9	45
41. Louisiana	17.8	19.9	19.4	36
42. Tennessee	21.0	25.0	22.3	43
43. Georgia	21.7 [4]	25.9	23.1	44
44. Arkansas	17.0 [5]	22.4	19.6	37
45. Mississippi	19.0	23.2	21.5	41
46. South Carolina	23.0	28.1	25.0	46
47. Alabama	22.1	17.2	25.2	47
Texas [6]				
United States, average	17.6	17.2	14.9	

1 Tied. 2 Only 1930 available. 3 1929–1930. 4 1928–1930. 5 1927–1930. 6 No figures available for earlier period.

Source: 1926–1937 figures from *Motor Vehicle Deaths and Death Rates, by States, 1926–1937*. Public Safety Memo. 94, p. 7. National Safety Council, Chicago, Ill.

1938–1939 figures derived from *Vital Statistics—Special Reports*, 9 [8], 17 and from U. S. Public Roads Administration Table G-21, 1938.

TABLE 54

SAFETY STANDING OF THREE SELECTED GROUPS OF STATES ACCORDING TO PRESENT STATUS AND RELATIVE IMPROVEMENT

Standing of States by Present Status and Improvement 1935–1939 over 1926–1930	Fatalities per 100,000,000 Vehicle-Miles			Per Cent Change in Rate
Column 1	Column 2 1926–1930	Column 3 1931–1934	Column 4 1935–1939	Column 5 1935–1939
Northeastern				
1. Rhode Island	17.4	8.6	6.8	−60.9
2. Connecticut	19.0	14.9	10.8	−43.2
3. Massachusetts	13.8	12.1	9.6	−30.4
4. New Jersey	19.9	16.8	11.6	−41.7
5. Delaware	21.2	17.6	12.9	−39.2
6. New York	18.3	15.8	12.8	−30.1
Average	18.3	14.3	10.8	−40.9
North Central				
9. Iowa [1]	10.8	12.8	10.3	− 4.6
14. Minnesota [1]	12.6	13.4	11.9	− 5.6
14. South Dakota [1]	10.3 [2]	11.3	10.2	− 1.0
22. Nebraska	10.8	11.7	11.4	+ 5.6
24. North Dakota	10 0	12.0	10.8	+ 8.0
29. Kansas	11.1	14.2	12.1	+ 9.0
Average	10.9	12.6	11.1	+ 1.9
Southeastern				
42. Tennessee	21.0	25.0	22.3	+ 6.2
43. Georgia	21.7	25.9	23.1	+ 6.5
44. Arkansas	17.0	22.4	19.6	+15.3
45. Mississippi	19.0	23.2	21.5	+13.2
46. South Carolina	23.0	28.1	25.0	+ 8.7
47. Alabama	22.1	17.2	25.2	+14.0
Average	20.6	23.6	22.8	+10.7
United States, average	17.6	17.2	14.9	

[1] Tied. [2] Only 1930. [3] 1928–1930. [4] 1927–1930.

Source: Same as that for Table 53, Chapter VIII.

The Safety Status of a Group of Northeastern States

The states of Rhode Island, Connecticut, Massachusetts, New Jersey, Delaware, and New York have made great progress in reducing accidents, and have, in addition, an excellent ranking on a fatality-per-vehicle-mile basis at the present time. On the basis of the various factors discussed in this chapter how, may we inquire, do they stand out in relation to other states?

First as regards *sampling of accidents.* Unquestionably, the use of fatalities alone as an index of safety status gives these states a much higher rating than they deserve, for, since they are densely populated and urbanized, they have a high proportion of personal injury and property damage accidents per fatal accident. Hence eventually, when more complete accident reporting is compulsory in all states, and safety status is measurable on a basis of fatal accidents plus non-fatal accidents, the northeastern states which have relatively more accidents of all kinds than the more sparsely populated states will have a less flattering record. With a broader type of safety index they would have to work harder than they do at present to maintain their high standing.

As regards *exposure,* the greater density of population and urbanization in the northeastern states increases the hazards from other users of the highway, and in particular multiplies typically urban types of accidents, e.g., pedestrian accidents, vehicle collisions at intersections, rear-end collisions.

As regards driving *speed* these states can be thankful that heavy traffic restricts driving speeds and thereby tends to lower the proportion of the fatal and more serious injury types of accidents.

As regards types of *drivers* there is little clear-cut information. The high economic status, excellent educational facilities, and low crime rate of these states would indicate that a large proportion of the inhabitants are comparatively well-to-do, well-educated, law-abiding citizens. But the high proportion of urban population with its wide differences in the status of the top and bottom strata of society, the latter of which contains a large element of the foreign-born, complicates the picture. Since, however, the standards for licensing are stricter here, drivers in these states are probably better trained and better acquainted with traffic laws than drivers in other parts of the country.

As regards *motor vehicles,* the higher economic status of the population, and compulsory vehicle inspection in four of the six states in this group, tends to reduce the likelihood of defective vehicles increasing accidents.

The progress and the high present standing of these states is attributable to a considerable degree to their excellent safety activities such as improved driver licensing and examining, better accident reporting and analysis and use of more complete accident data, ready suspension and revocation of the licenses of traffic violators and drivers who incur accidents, adequate highway patrolling, high school driver training, and cooperative efforts by newspapers, radio, and community safety councils.

The Safety Status of a Group of North Central States

The high standing of certain north central states fifteen years ago, ten years ago, and today as well, despite the fact that organized safety activities have been carried on there for only a few years, is attributable principally to certain conditions inherent in this region which favor driving safety independently of organized preventive activities.

As regards *sampling of accidents*—since there are relatively few users of the highway in these states the number of non-fatal accidents is undoubtedly very low. Already rating low in number of fatalities per vehicle-mile, the standing of these states on the basis of all accidents per vehicle-mile would (if they were available) probably be far superior to any other states in the country. The fatality-per-vehicle-mile index, if anything, minimizes the high standing of these states.

The *exposure* of drivers in these states is probably less than of operators in other parts of the country. A few of the factors which tend to lessen the number and seriousness of the hazards encountered are the topography of the region, the type of roads, the few cars per mile of road, the sparse rural population, and the climate.

These states are situated in the flat plains of the upper Mississippi valley. Since they have few trees, they have good visibility on curves and turns. The roads are generally straight, not having to follow an irregular route to avoid steep grades.

With the exception of Iowa these states have relatively few miles of concrete highway and many miles of none too well maintained gravel and unimproved roads. The large proportion of unimproved roads tends to discourage high speeds.

The small number of cars per mile of road in these states (see Table 42) decreases the encounters of motor vehicle with motor vehicle and lessens the chances of collisions.

The predominantly rural and relatively sparse population keeps down the number of pedestrians on the roadways and reduces accidents involving pedestrians. Fewer intersections also decrease the danger of intersectional collisions.

During the summer, when the peak of driving occurs in these states, the days are long, reducing the proportion of the more hazardous driving after dark. In winter, when the days are short, the inclement weather discourages the use of cars and thereby reduces the chances of accidents.

As was indicated above, the low mileage of high-type roads reduces average driving speeds and therefore minimizes *speed* as a factor in producing accidents.

The percentage of illiteracy in these states is small. Educational facilities on the whole are excellent. Crime is negligible. Health is good. The economic status of the individual is comparatively low, but on the other hand few people are out of work and there is little destitution. All these conditions contribute to an intelligent, law-abiding, hard-working, self-respecting type of citizen, the kind who should also make a good *driver.*

The *motor vehicles* in use in this region are probably above the average in age, and not too well maintained, but since they are not used so much during the dangerous winter season and, apparently, are intelligently driven, they probably play a minor role in influencing the excellent safety standing of these states.

To sum up, since these states have always had good fatality-per-vehicle-mile records, and have not been noted for accident-prevention activities, especially in the earlier days, we may ascribe their excellent standing in large part to the favorable conditions of travel which permit driving with a minimum of hazards. The high quality of their drivers also contributes to their good standing.

The Safety Status of a Group of Southeastern States

A fairer measure of the standing of these states which would include their rating in *all types of accidents* would probably place them higher up on the safety scale, giving them a better non-fatal-accident-per-vehicle-mile index than states like those in the northeast which have both a higher density of population and a larger urban population. Although the southeastern states have a fairly high density of population, they have a low percentage of urban population, indicating that their accidents are predominantly of the fatal variety. Safety efforts in these states should therefore be directed primarily at this type of accident.

The larger amount of driving during the winter season when road conditions are more dangerous and twilight hours come earlier adds to the hazards of southern drivers. In addition, the availability of more miles of high-type-surface highway per motor vehicle, together with little traffic and few highway patrolmen, tends to increase the incentive to *speed.* The density of rural population heightens the chances of motor vehicles

colliding with pedestrians, whereas the lack of fencing laws leads to more collisions with animals. This combination of factors increases the *exposure* of the drivers in these states and predisposes them to more accidents, particularly those of a fatal and serious injury variety.

The larger proportion of negroes, who seem to make less safe pedestrians as well as drivers, undoubtedly contributes to the high fatality rate in these states, but regardless of whether the average southern motorist is better or worse as a *driver* than the motorist from other parts of the country, the important point to emphasize is that the southern driver can be improved. The southern states by emphasizing better motor vehicle administration, police enforcement, and safety education can unquestionably make their drivers the equal of those of any other region.

As for *vehicles* there is little evidence that they contribute much to the high fatality rate in the southern states. The lower economic status of the citizen would seem likely to discourage his spending so much money on the upkeep of his vehicle as drivers in northern states. If this were known to be true, it could be argued that the vehicles in these states are in less safe operating conditions, but having no facts at our disposal it is useless to pursue the matter further.*

In sum, the poor fatality-per-vehicle-mile rate in these states can be attributed to a combination of circumstances: fairly high exposure, high driving speeds, and lax control of drivers. These conditions coupled with a general unwillingness to expend funds on necessary safety activities give these states the unenviable reputation of ranking lowest in the country on a fatality-per-vehicle-mile basis.

NECESSITY FOR MORE CAREFUL STUDY OF THE FACTORS INFLUENCING SAFETY STATUS

As has been pointed out in this chapter, the factors influencing safety status are numerous and complicated. Our knowledge of them at the present time, being extremely sketchy, is far from adequate, although without an understanding of these factors our measurements of safety status among states have little meaning.

Only by a systematic study of the relative importance of the factors affecting the safety status of states and regions, and of their interrelationships, will we be able to make valid comparisons. Until we have this knowledge, our indices of safety standing are bound to be misleading and of limited service in indicating how to tackle the safety problem with maximum effectiveness in each state. Research organizations in states are badly needed to study local problems to ensure that safety activities are directed along the most effective as well as the most economical lines.

* Tennessee, South Carolina, and Mississippi do have a form of vehicle inspection.

CHAPTER IX

INCOMPETENT DRIVERS

Two of the most important special problems confronting agencies in charge of highway accident reduction are to deal with accident repeaters and to protect pedestrians. This chapter will be concerned with the accident repeater, how many there are, how bad they are, who they are and how to protect the public against them. The facts about accidents involving pedestrians will be surveyed in Chapter X, where the proposed remedies for pedestrian accidents will be discussed.

WHAT PROPORTION OF DRIVERS HAVE ACCIDENTS?

In 1937 an extensive study of accident drivers was carried out in the Connecticut Motor Vehicle Department by the U. S. Public Roads Administration. [237] Accident records of a sample of 29,531 operators who were licensed continuously in Connecticut for the six years 1931 through 1936 * were examined and all fatal, personal injury, and property damage accidents amounting to a total of $25 or more incurred by these drivers were tabulated.

Table 55 shows the distribution of accidents among the drivers whose records were studied.

About 19 per cent of the operators had all the accidents. Fifteen per cent had only one accident in six years. The latter might be termed occasional-accident drivers in contrast with the more than 80 per cent who went for six years without an accident.

The most important discovery, however, was that 3.9 per cent of the drivers had two or more accidents each and accounted for 36.4 per cent

* Those operators whose licenses were suspended for definite periods of time, but who were later reinstated, were included.

In studies of this kind in order to obtain a comparable group it is necessary to check on whether drivers were licensed during the whole period in question. The longer the period, the fewer will be the motorists who have operated continuously. Of course few persons actually drive continuously—many drivers go for days, weeks, months, and oftentimes, even though they may continue to be licensed, for years, without driving—but so far, accident studies have not yet found it possible to control this exposure factor properly.

TABLE 55

PERCENTAGE DISTRIBUTION OF DRIVERS ACCORDING TO NUMBER OF ACCIDENTS

(Connecticut, 1931–1936)

Number of Accidents per Driver	Percentage of Drivers	Percentage of Accidents
0	80.9	0
1	15.2	63.6
2	3.2	26.4
3	0.5	6.8
4 or more	0.2	3.2

Source: Adapted from "The Accident-Prone Driver," Part 6, *Motor-Vehicle Traffic Conditions in the United States,* House Document 462, p. 19. U. S. Government Printing Office, Washington, 1938.

of all the accidents incurred during the six-year period. The report itself gives a refutation of the possibility that such a distribution of accidents obeys the laws of chance. [237]

As a group these accident-repeater drivers were credited with 39.8 per cent of the fatal accidents, 35.2 per cent of the personal injury accidents, and 37.4 per cent of the property damage accidents, indicating that they participated in an approximately equal share of reported accidents of different degrees of seriousness.

Earlier investigations of accidents involving both passenger car operators and commercial drivers corroborate the findings of the study reported above. [24, 34, 148, 178, 196] These studies contradict the belief in some quarters that accidents are distributed uniformly among a large number of average drivers and that the accident-repeater driver has only a small percentage of all the accidents. [108, 124] *

We see from these different studies that at any particular time a survey of the accident histories of a group of motorists over a period of years will yield three classes: (1) those who have had no accidents; (2) those who have had an occasional accident; and (3) those who have had two or more accidents.

The percentages of the driving population falling in the different groups will of course vary according to the number of years covered by the study and the total number of drivers whose accident records are available during the interval. Naturally the longer the period of time studied, the smaller will be the group of accident-free operators and the larger the

* For example, one author says: "The best estimate is that 5 per cent of the drivers (the repeaters) have about 15 per cent of the accidents. The balance of the accidents, about 85 per cent, are divided up among the 95 per cent of us who are average drivers. Jones and Smith. You and me." [124, 8]

groups of occasional-accident and accident-repeater drivers. All the studies yet made cover relatively short periods of time. We cannot, therefore, say very much more at the present time about the relative growth in numbers and importance of occasional-accident and accident-repeater groups of drivers over periods of time longer than six years.

There is, however, evidence to show that the probability that accident-repeater drivers will have future accidents is considerably greater than it is for the occasional-accident driver, or the accident-free driver.

EXTENT TO WHICH DRIVERS WHO HAVE HAD ACCIDENTS ARE LIKELY TO CONTINUE TO HAVE THEM

The Connecticut study proves that groups of drivers who have gone for years without accidents continue to have comparatively good records, and groups of drivers who have had many accidents continue to incur them. Thus in Table 56 drivers who had two accidents during the first period

TABLE 56

ACCIDENT SUSCEPTIBILITY OVER A THREE-YEAR PERIOD OF DRIVERS WHO HAD VARYING NUMBERS OF ACCIDENTS DURING THE PRECEDING THREE YEARS

(Connecticut, 1931–1933 and 1934–1936)

Number of Accidents per Driver During First Period	Number of Accidents per Driver During Second Period
0	0.1
1	0.2
2	0.3
3	0.5
4	0.7

Source: Adapted from "The Accident-Prone Driver," *Motor-Vehicle Traffic Conditions in the United States*, Part 6, House Document 462, p. 29. U. S. Government Printing Office, Washington, 1938.

had three times as many accidents during the second period as those drivers who were accident-free during the first period. Persons who had four accidents during the first period had seven times as many accidents during the second period as did those who had no accidents during the first period.

Studies made in England also indicate that drivers who are involved in three or more accidents during the first year of driving subsequently have a higher accident rate than drivers who have no accidents in their first year. [99, *35*]

These studies indicate that the chances that an accident-repeater driver will get into future accidents are very much greater than the chances of

an accident-free driver getting into future accidents, and that the more accidents a driver has, the more likely he is to be involved in additional accidents. This point is seldom realized by motorists who have accidents and is rarely emphasized in safety propaganda.

WHAT IS THE ACCIDENT EXPECTANCY OF THE UNSELECTED DRIVER?

The other day a friend of mine who had just had an automobile accident in which someone was injured remarked: "This is the only accident I've had for five years. Of course, everybody has to have accidents some time. I'm doing pretty well, don't you think?"

Contrary to my friend's opinion, the truth of the matter is that a driver who has even one injury accident every five years belongs to a relatively small group of unsuccessful drivers since, if every driver had an equal chance of having accidents, the average driver, as will be shown presently, would have an injury accident only once in every forty years.

Common sense tells us that human beings will make good, bad, and indifferent drivers just as well as good, bad, and indifferent participants in other types of activity. The occasional-accident driver admits this but insists that he belongs to the good-driver group. His error in minimizing the importance of his occasional accident lies in his failure to appreciate how seldom the average driver has an accident and how many drivers never have accidents.

One difficulty in determining the accident expectancy of average drivers lies in the inadequate reporting of accidents. Accidents vary in seriousness all the way from those involving a fatality, down through injury and heavy property damage accidents to insignificant fender scratches involved in parking a car. It is commonly agreed that all road mishaps resulting in fatalities and non-fatal personal injuries are serious enough to be counted as accidents.* Differences in definition arise particularly when the question of property damage accidents is considered (see Chapter VI).

If we define an accident as a traffic mishap involving death, personal injury, or property damage amounting to over $25 in cost of repairs, which is the figure recommended by the Uniform Vehicle Code, what is the ratio of drivers in accidents to all drivers? Under the Connecticut

* Although certain members of the driving public magnify minor injuries such as a shake-up or bruised finger in order to claim damages, ordinarily a personal injury accident is regarded as one in which first aid or the services of a doctor are required.

and New Jersey accident reporting systems (requiring reporting of all accidents involving more than $25 damage) we see in the accompanying table that, assuming that no driver has more than one fatal accident in any year, the odds that a driver will have a fatal accident in any one year period are approximately about one in 1,300. The chances of having a

TABLE 57

ACCIDENT PARTICIPATION OF LICENSED DRIVERS
(Connecticut and New Jersey, 1939)

Type of Accident	Number of Accident-Free Drivers for Each Driver Involved in an Accident	
	Connecticut [1]	New Jersey [2]
Fatal	1,368	1,335
Personal injury	39	47
All reportable accidents (including property damage)	16	19

Sources: 1 *Traffic Topics, Statistical Summary, 1938–1939.* Department of Motor Vehicles, Hartford, Conn.
2 *Twenty-Fourth Annual Report of the Commissioner of Motor Vehicles of the State of New Jersey for the Year 1939.* Trenton, N. J.

personal injury accident are roughly one in 40, and of having a reportable accident one in 20. These probabilities are of hypothetical significance for, of course, not all motorists are average performers, some will have larger expectancies and some smaller.

Let us next take up the question: "Are drivers in fatal accidents average drivers?"

DRIVERS IN FATAL ACCIDENTS CONTRASTED WITH UNSELECTED DRIVERS

A convincing proof of the relation between past poor record and continued poor performance is given by the following study.

The table compares the accident records of a group of 100 operators who had just had a fatality with a group of 100 operators selected at random. Seven per cent of the drivers involved in fatal accidents were operating without a license, as compared with none in the other group; and 12 per cent were inexperienced and operating on their first license, whereas there were no inexperienced drivers in the random group. Twenty-five per cent of the fatal-accident drivers had had a serious record

TABLE 58

COMPARISON OF RECORDS OF 100 OPERATORS IN FATAL ACCIDENTS WITH RECORDS OF 100 OPERATORS TAKEN AT RANDOM

(Massachusetts, 1931)

Records of Drivers	Drivers in Fatal Accidents	Drivers Selected at Random
	Per cent	*Per cent*
Clear record	34	75
Serious record during preceding year	25	5
Record of minor traffic violations	22	20
Operating without a license	7	0
Inexperienced, operating on first license	12	0

Source: Charles S. Slocombe, *Summary of Studies of Accident Drivers in Connecticut and Massachusetts,* p. 2 (mimeo). Yale University Institute of Human Relations, New Haven, Conn.

during the preceding year, whereas only 5 per cent of the drivers from the general driving population had had a record of this kind.

WHAT IS THE ACCIDENT EXPECTANCY OF CHRONIC VIOLATORS?

Another indication that bad drivers have bad records is contained in a study made in Wichita, Kansas, of the relationship between drivers having traffic violations (including all violations incurred while the car was moving) and drivers involved in accidents. Note Table 59 that drivers who had one or more violations had proportionately more accidents than those drivers who had had no violations. Drivers who had had five or more violations had over six times as many personal injury accidents per

TABLE 59

PERSONAL INJURY ACCIDENTS OF VIOLATOR DRIVERS ACCORDING TO THE NUMBER OF THEIR PREVIOUS VIOLATIONS

(Wichita, Kansas, 1931-1937)

Violations	Drivers	Personal Injury Accidents	Personal Injury Accidents per 100 Drivers
0	500	18	3.6
1	500	39	7.8
2	500	51	12.0
3	500	68	13.6
4	273	45	16.4
5 or more	406	94	23.1

Source: Adapted from *The Driver,* p. 25. Wichita Police Department, Wichita, Kan., 1938.

100 drivers as the non-violators. This study clearly indicates the need of including data on driving violations in the permanent records of motorists, since chronic violators have a greater than normal expectancy of incurring accidents.

LIMITATIONS TO THE USE OF ACCIDENT RECORDS IN PREDICTION OF FURTHER ACCIDENTS

There is no longer any doubt that there are operators in our driver population who have more accidents than they would be expected to have on the basis of chance. Even though we know that as a group such drivers will also continue to have bad accident records during a second consecutive period, we cannot definitely predict that any one individual in such a group will continue to have accidents, nor can we say that individual drivers who have no accidents during a certain period will continue to drive without incurring accidents.

Regardless of our inability to use accident records with complete assurance to predict an individual's future accidents, if we want to effect a considerable reduction in accidents at minimum expense and with the least inconvenience to the vast majority of accident-free and occasional-accident motorists, we should attempt to curb the relatively small number of accident-repeater drivers whose accident expectancy is much higher than that of the normal driver.

WHO ARE THE INCOMPETENT DRIVERS?

Let us now consider the question: "Who are the incompetent drivers?" Two classes of poor drivers are readily distinguishable. One consists of young, inexperienced drivers, whereas the other is made up of older, maturer drivers, who become involved in accidents despite their experience. [137, 67]

The Young, Inexperienced Poor Driver

Studies made in Connecticut indicate that a greater proportion of young drivers have accidents than any other age group. Table 60, compiled from one investigation, shows that whereas almost 8 per cent of the drivers under 20 were involved in accidents, only about 4 per cent of the drivers over 50 years of age had accidents.

On the basis of mileage driven, the fatal-accident rate for young drivers in their teens is twice as great as it is for operators in their twenties and

TABLE 60

PERCENTAGE OF DRIVERS IN DIFFERENT AGE GROUPS INVOLVED IN ACCIDENTS
(Connecticut, 1932–1936)

Age of Drivers	Percentage of Drivers Involved in Accidents
16–19	7.9
20–29	7.0
30–39	5.4
40–49	4.9
50–59	4.3
60 and over	4.3

Source: Adapted from data furnished by the Connecticut Motor Vehicle Department.

three times as great as for operators in their forties and fifties (Table 61). This fatality rate decreases with advancing age up to 60, but thereafter rises slightly.

TABLE 61

FATALITIES INCURRED BY OPERATORS OF DIFFERENT AGES PER 100,000,000 VEHICLE-MILES DRIVEN
(Connecticut, 1937)

Ages of Drivers	Fatalities per 100,000,000 Vehicle-Miles Driven
16–19	20.9
20–29	11.2
30–39	8.7
40–49	6.8
50–59	6.7
60–69	9.2
70 and over	12.7

Source: Adapted from data furnished by the Connecticut Motor Vehicle Department.

Note on Table 62 the much higher proportion of fatal accidents incurred by young drivers within three years of first obtaining a license than that incurred by older drivers. This study shows that drivers who were under 20 years of age when they were examined were involved in fatal accidents nearly twice as frequently as the average driver examined and over five times as frequently as persons 50 years of age and older.

Obviously both lack of experience and youth handicaps young drivers. It is impossible, however, to determine from the data at present available which of these factors is of greater importance. Some evidence showing that accidents are more closely correlated with age than with experience is contained in an old study of the relative influence of experience and age on accidents. [212]

TABLE 62

DRIVERS INVOLVED IN FATAL ACCIDENTS WITHIN THREE YEARS OF PASSING LICENSE EXAMINATION CLASSIFIED BY AGE OF DRIVER WHEN EXAMINED

(Connecticut, 1931–1933)

Age When Examined	Drivers Examined	Drivers Involved in Fatal Accidents in Succeeding Three Years	Drivers Involved in Fatal Accidents per 1,000 Drivers Examined
16–19	4,233	25	5.9
20–29	7,048	20	2.8
30–39	4,331	10	2.3
40–49	1,995	3	1.5
50 and over	854	1	1.2

Source: Adapted from *Identified Drivers in Fatal Accidents.* Unpublished report by Hilda Keller, Connecticut Motor Vehicle Department, Hartford, Conn.

In investigations of accident repeaters made in Connecticut and Massachusetts, Slocombe found that repeaters were more common among young men than among older men (see Table 63). Twenty-two per cent of the operators he studied were between 20 and 30 years old yet 38 per cent of

TABLE 63

AGE DISTRIBUTION OF OPERATORS AND REPEATERS

Ages of Drivers	Percentage Distribution of Operators Studied	Percentage Distribution of Repeaters
20–29	22	38
30–39	34	38
40–49	23	15
50–59	14	8
60–69	5	1
70 and over	2	0

Source: Charles S. Slocombe, *Summary of Studies of Accident Drivers in Connecticut and Massachusetts,* p. 9 (mimeo). Yale University Institute of Human Relations, New Haven, Conn.

the repeaters were in this group. Drivers over 40 years of age constituted 44 per cent of the drivers and yet made up only 24 per cent of the multiple-accident drivers. In proportion to their number the drivers between the ages of 20 and 30 included the largest proportion of accident repeaters. Teen-age drivers were not included in this summary.

Similar results were obtained in a study of drivers in Massachusetts who were called in to the Registry of Motor Vehicles for a hearing be-

cause they had been involved in two accidents within a period of six months. In proportion to the number of licensed drivers in their age group, the younger drivers were nearly twice as numerous as would be expected. Although only 36 per cent of licensed drivers in Massachusetts were under 30 years of age, 65 per cent of the repeaters were below this age.

TABLE 64

AGE DISTRIBUTION OF LICENSED DRIVERS AND OF REPEATERS CALLED IN FOR HEARINGS

(Massachusetts)

Ages of Drivers	Licensed Drivers	Repeater Drivers Called in for Hearings
19 and under	6	12
20–24	14	26
25–29	16	27
30–34	16	12
35–39	13	8
40 and over	35	15

Source: Charles S. Slocombe, *Summary of Studies of Accident Drivers in Connecticut and Massachusetts*, p. 9 (mimeo). Yale University Institute of Human Relations, New Haven, Conn.

A fundamental reason why young people have such a high accident rate is that they do much of their driving at night and on week ends when driving is much more dangerous. Statistics show that young people not only have a very high accident rate, but also have an excessive proportion of their accidents at night (see Table 10).

Present-day youth has developed nocturnal recreational habits which from a safety standpoint are highly undesirable. Twenty-five years ago young people considered themselves fortunate if in the evening they could go to a neighborhood movie or a well-chaperoned party a few blocks away from their homes. Nowadays a young man thinks he must borrow the family car, collect a group of his friends and rush all around the country looking for entertainment. Often encouraged by alcoholic refreshments he is lured into demonstrating to his companions how fast "the old bus" will go, with disastrous results.

If the number of accidents in which the younger generation is involved is to be reduced, parents must exercise more control over the nocturnal adventuring of their youngsters. For their children's own protection parents should supervise more carefully the use of the family car. They should encourage the younger generation to find more of their evenings' amusements nearer home and make them confine their extended motoring to the daytime when driving conditions are safer.

Parents should also see to it that their children receive adequate driving instruction. They should encourage them to take advantage of any driver

training courses offered in the community, or if no driver training courses are available, they should make provision for them to receive instruction from some competent professional driving teacher. They should make certain that they are thoroughly qualified to drive alone before they are allowed to apply for a license.

After a youngster secures a license, parents should give his driving as much supervision as possible. They must endeavor to make him realize his responsibilities as a driver, to himself, to other occupants of his car, to other drivers, and to pedestrians. Much can be done to check the high accident rate of young persons if parents will follow these suggestions.

Many young accident repeaters come from the lower economic class whose families cannot afford a car, and who, consequently, drive borrowed autos, commercial vehicles on off-time, or jalopies owned jointly with several other penniless young fellows. Their families, not having any money or property which may be attached for damages, concern themselves little with their children's driving activities, which are characterized by carelessness and irresponsibility.

Conspicuous are the accidents caused by young men in this group who take strangers' cars for joyrides. Naturally persons whose upbringing does not inhibit them from stealing the property of others to satisfy their desire for a thrill are not going to make very dependable drivers.

On the other hand, a small but none the less noticeable group of young male accident repeaters familiar to motor vehicle departments come from wealthy families who also lack the sense of civic responsibility to curb the driving excesses of their offspring. These young men, seeing that Father is able and willing to pay for accidents caused by their recklessness, develop much the same negligent, imprudent attitude as the one who knows that he and his parents cannot be held financially responsible.

The Mature, Experienced Poor Driver

Young, inexperienced drivers have a greater accident expectancy, either in relation to the number driving or the mileage driven, than drivers in any other age group. It is only fair to point out, however, that, taken as a group, the accidents of young drivers and of inexperienced drivers constitute only a relatively small proportion of the total number of accidents. The majority of accident repeaters as well as of the occasional-accident drivers come from the group of mature, experienced drivers, who, of course, are much larger in numbers.

Table 65 shows the distribution of licensed drivers and accident drivers in Connecticut by age groups. Operators under 20 years of age, who

number 5.0 per cent of all licensed drivers, constitute only 6.9 per cent of all drivers in accidents. They therefore play a relatively minor part in the whole accident picture. Even if we were to rule off the road all drivers below the age of 25 we should still leave unaffected practically three-quarters of the drivers in accidents.

TABLE 65

AGE DISTRIBUTION OF LICENSED DRIVERS AND OF DRIVERS IN ACCIDENTS

(Connecticut, 1937)

Age of Drivers	Licensed Drivers	Drivers in Accidents
	Per cent	*Per cent*
16–19	5.0	6.9
20–24	14.4	19.6
25–29	15.9	17.4
30–34	28.2	26.5
40–49	20.4	17.5
50–59	10.8	8.1
60 and over	5.3	4.0

Source: Adapted from data furnished by the Connecticut Motor Vehicle Department.

Other statistics show that the largest proportion of drivers in accidents are mature adults who have had several years' driving experience.

TABLE 66

PERCENTAGE DISTRIBUTION OF DRIVERS IN ACCIDENTS BY YEARS OF DRIVING EXPERIENCE

(Seventeen states, 1940)

Driving Experience in Years	Drivers in Accidents
	Per cent
Under 1	2.8
1 to 5	21.3
6 to 10	22.7
11 and over	53.2

Source: Derived from the annual statistical summaries of the following states: Ala., Ariz., Ark., Conn., Ga., Ind., Ia., La., Minn., Neb., N. J., Tenn., Tex., Utah, Va., Wash.

THE INFLUENCE OF EXPOSURE, SPEED, AND SKILL ON ACCIDENT SUSCEPTIBILITY

Studies which will furnish definite evidence of the effect of exposure on accident rates and more particularly on the contribution of exposure to the creation of accident repeaters are greatly needed (Chapter II). Until we have facts at our disposal to indicate the part played by exposure

in producing high-accident-rate drivers, our understanding of the factors underlying the problem of incompetent drivers will be incomplete.

As regards speed (Chapter III) a higher proportion of young than old operators drive at high speeds, but since there are many more mature, experienced operators on the road, they constitute the majority of speeding drivers. Speeding is not primarily a youthful sport, but is indulged in by drivers of all ages.

As for skill (Chapter IV) few older drivers have had any formal driver training, since driver training has been initiated only within the last few years (Chapter XIII). Although experience may result in more skillful driving this does not necessarily follow unless the will to improve plus some knowledge about how to learn is present. The majority of mature drivers on the road today appear to have little desire to become better drivers.

With advancing age, skill and sensory capacity decline, and the need to compensate for loss in ability by driving more slowly and cautiously arises. Fortunately age usually brings with it conservatism and caution and a heightened sense of social responsibility. As a rule therefore older people dislike fast motion and risks. They are usually more "safety-minded" than young people. Other factors such as exposure, driving speed, and skill being equal, older drivers are therefore less prone to accidents than young people (see Chapter V).

CASE STUDY OF AN ACCIDENT REPEATER

The following case study is typical of the careers of some of our notably undesirable drivers.

Case of Mr. M

1927	May	Charged with reckless driving. License suspended.
1928	June	License reissued.
1928	September	Operating under influence of liquor. License suspended.
1929	September	License reissued.
1929	November	Court conviction, speeding. Ten dollars.
1930	March	Personal injury accident, at fault. License suspended.
1930	April	License reissued on favorable report on his character.
1930	June	Court conviction, speeding. Ten dollars.
1931	September	Fatal accident, at fault. License suspended.
1932	March	License reissued after hearing.
1932	April	Court conviction, speeding. Twenty dollars.

1933	February	Personal injury accident, at fault. License suspended.
1933	June	License reissued.
1934	July	Serious accident, two persons injured, not at fault.
1935	January	Accident, no one injured, property damage $100, at fault.
1937	April	Personal injury accident, at fault. License suspended.
1937	October	License reissued.

This case history, and there are all too many like it, raises a number of pertinent questions about the effectiveness of the administration of the driver license law. Why, for example, should an operator who had a previous record of reckless driving, drunken driving, and speeding have his license suspended for only one month after a personal injury accident? And why after a subsequent fatal accident was his license reissued after only six months' suspension? And why after a third accident was this man's license reissued after only four months' suspension? Whose favorable report of this man's character was given so much weight that he was allowed repeatedly to resume his career of injury and destruction on the highway? Why was not the punishment increased for each successive violation and accident? And why, may we ask, was a driver so obviously dangerous and incompetent not eventually permanently forbidden to drive?

In view of such laxity in our punishment of the chronic violation- and accident-repeater driver, drastic changes in our methods of controlling him are called for. Chief among these should be the following:

1. States should keep permanent cumulative records of the violations and accidents of all drivers in order to locate the repeaters.
2. The authority to suspend and revoke licenses should be used more frequently as a punitive measure.
3. This authority should be taken out of the reach of politics.
4. A system of cumulatively increased punishments for successive violations and accidents should be instituted.
5. The licenses of inveterate bad drivers should be suspended for long rather than short periods, and the licenses of operators with flagrant records permanently revoked.

FINANCIAL PROTECTION FOR VICTIMS OF AUTOMOBILE ACCIDENTS *

Angelo Pacelio was killed while crossing at an intersection. The driver who hit him was found by the police to have been drinking and was arrested for homicide but later turned loose. The widow received $500 life insurance, a considerable share of which she had to pay for funeral expenses. The guilty driver could pay no compensation. The widow and child are now living with the aid of occasional gifts from her husband's former employee and food from neighbors.

Patrick Figurniak, a laborer, was injured in an automobile accident, and had both legs fractured. His wife and children managed somehow while he was in the hospital. On account of his inability to do hard labor Patrick was refused employment when he returned to work. He borrowed from relatives, used up his small savings. The rent fell behind. Six months later Patrick and his family were taken in by his wife's parents. There was no compensation.

The above cases are typical of tens of thousands which continue to take place yearly because our society has made inadequate provision to compensate the victims of automobile accidents. One reason for this state of affairs is that the growth in the number of automobiles has extended the ownership of motor vehicles into the very lowest income classes. As a consequence there are large numbers of motorists who do not have sufficient incomes or resources to compensate other citizens for driving injuries or damages which they may inflict upon them.

Car owners in higher income groups who have property which they feel the need of protecting against court judgments resulting from car accidents usually take out accident liability insurance. The majority of operators, however, feel unwilling or unable to purchase such insurance until compelled to do so, as they are in Massachusetts.

In many cases of serious accidents, the dependents of those killed receive no compensation or an insufficient amount for their bereavement and loss of support. A study in Connecticut showed that when all forms of compensation, whether from insurance, liable party, employer, etc., are lumped, 67 per cent of the temporary injuries and 72 per cent of the permanent injuries from automobile accidents had received less than the actual expenses of the accident. [61, *470*] In many minor cases, on the other hand, persons who are "claim-minded" and unscrupulous receive too much compensation.

* I wish to acknowledge my indebtedness to Ralph H. Blanchard of Columbia University, Shippen Lewis of Philadelphia, and Robert J. Maloy of the New York Motor Vehicle Department for advice and criticism of this section. This does not mean, of course, that they necessarily concur with everything I say.

Financial-Responsibility Laws

One step in the direction of solving this problem has been the adoption of financial-responsibility laws by a number of states. For years states have had laws to provide for the aged, the mentally ill, the blind, the physically handicapped, the unemployed, and for the workman injured in the performance of his duties, but it was not until 1925 that Connecticut passed the first state law to make some provision for those injured as a result of motor vehicle accidents. Other New England states adopted laws based on the Connecticut statute and gradually financial-responsibility, or safety-responsibility laws, as they are sometimes referred to, spread until there are now about forty states with some form of highway accident compensation law.

The most popular form of financial-responsibility law is that recommended by the National Conference on Street and Highway Safety in Act IV of the Uniform Vehicle Code. It has these three features:

1. A requirement of proof of financial responsibility following conviction of serious motor vehicle offenses (such as drunken driving, or hit-and-run driving). This proof may take the form of accident insurance, a bond, or a cash deposit.
2. A requirement of proof of financial responsibility following the non-payment of motor vehicle accident judgments.
3. The suspension of the right to operate a motor vehicle until such judgment has been satisfied.

In an illuminating study of the administration of financial-responsibility laws in the various states, Professor N. P. Feinsinger of the University of Wisconsin Law School points out that the objectives of most financial-responsibility laws are as follows: [102, *522*]

1. To segregate the bad driver.
2. To prevent or decrease automobile accidents.
3. To compel the known bad driver to insure.
4. To procure payment of past damage.
5. To increase the proportion of insured cars or drivers.

These objectives, however, he goes on to point out, are seldom achieved. As regards the first point, bad drivers can be segregated by a cumulative accident-record file independently of a financial-responsibility law; hence the law cannot be regarded as a prerequisite to the attainment of this goal.

Concerning the second item, little or no factual evidence has ever been presented to prove that a financial-responsibility law reduces or prevents

accidents. [102, *523;* 159, *29*] If the adoption of a financial-responsibility law has any such effect, it is probably much less important than that of other measures which are outlined in Chapters XIII and XIV. In a state with a financial-responsibility law, bad drivers who are threatened with suspension or revocation may continue to drive if they can furnish proof of financial responsibility or pay for previous damage, or in some cases do both. In other words, to the very extent that the law is effective in obtaining proof of responsibility or payment of damages it fails to remove bad drivers from the road and thus fails to prevent accidents. Only in a relatively few extreme cases is the wrongdoer barred from the road despite his financial responsibility. Further, the effectiveness of any provision barring financially irresponsible bad drivers from the road depends not so much on the law as such, as it does on the efficiency of the state and city police in keeping a careful check on persons who have been forbidden to drive. Unfortunately far too little activity of this sort is carried out by the police at the present time.

The usefulness of a financial-responsibility law in accomplishing the third objective, that of compelling bad drivers to insure, is questionable. Many bad drivers who have been compelled to take out insurance as proof of financial responsibility after an accident, let their insurance lapse after the required period (usually three years). Others, accepting the license suspension, continue to drive without benefit of insurance or license. Still others procure licenses under false names; or take out licenses in neighboring states; or, where their car registration is not revoked, get some other member of the family to drive them. In Connecticut, the proportion of insured cars involved in accidents to all cars so involved has diminished steadily from 1930, dropping from 73 per cent in that year to 54 per cent in 1935. [102, *524*] These figures would indicate that in Connecticut the chances of a financially responsible insured driver being in an accident with an uninsured motorist are steadily increasing.

As regards point four, theoretically the guilty party in an accident is supposed to pay for the damages, but in actual practice in many cases he does not. One reason is that when the injured party finds that the driver to blame is insolvent he often decides not to go to the trouble and expense of trying to obtain a court judgment. The other is that unless the guilty party has resources, a court judgment against him is of little value. The net result in most states is much less favorable to the injured party than the law intended. [102, *529*]

As for five, there is little evidence that a financial-responsibility law actually has much influence on increasing the total amount of automobile insurance in the state, since the number of cases in which the law is in-

voked ordinarily are comparatively small and of short duration.* Most financial-responsibility laws operate only for the more serious fatal and personal-injury accidents. An exception is the most recent state financial-responsibility act—that just passed by New York State—which requires deposit of security or insurance for injury or damage in excess of $25. [177] †

In sum, therefore, although financial-responsibility laws are in use in the majority of states, there are few data to show that they accomplish much to protect the good driver from the incompetent one. On the other hand, it must be admitted that the fact that financial-responsibility laws have been adopted by 40 or more states is evidence that this type of legislation has important qualities that make it acceptable to legislators and insurance companies. But unless it can be shown that financial-responsibility laws actually do reduce accidents, it would be well in the future to let financial-responsibility acts stand on their merits for compensating the victims of accidents, and not claim for them virtues which they do not possess.

Compulsory Insurance

Compulsory insurance, such as has been in force in Massachusetts, Great Britain, Finland, Sweden, Norway, Denmark, Switzerland, Germany, Austria, and Czechoslovakia for years offers the public better financial protection against bad drivers than does financial-responsibility legislation.‡ The critics of compulsory insurance, who are chiefly insurance men, do not deny that in Massachusetts it has accomplished its main purpose of making the owner of every vehicle § licensed in the state financially responsible for whatever damage his car may cause.

The Massachusetts Compulsory-Insurance Act. A compulsory-insurance act, like a financial-responsibility act, has little effect on the accident rate of a state. Massachusetts figures on accidents before and

* In Pennsylvania the total number of new policies taken out to comply with the financial-responsibility law amounted to only 7,680 after four years, although the state has over 2,000,000 licensed operators. [159, *30*]

† The New York act approximates more closely to a compulsory insurance act than any previous financial-responsibility law. However, unlike compulsory insurance, the New York law (1) fails to compensate the victim of a motorist who cannot give security, (2) is complicated and expensive to operate, and (3) perpetrates an injustice by suspending the licenses of all uninsured operators or owners of vehicles in accidents before the court positively determines whether suspensions should be made.

‡ See two articles by Francis Deak [70, 71] for discussions of compulsory insurance in Europe. See also Lyman Brownfield's summary of state and federal compulsory-liability insurance requirements for commercial motor vehicles. [43]

§ There is, of course, some evasion, but for practical purposes the law may be said to cover all cases.

after the passage of the compulsory-insurance act show that the latter apparently had no effect either on increasing or decreasing accidents. [168, *21;* 39, *552*]

Speaking of the opposition of insurance companies to compulsory insurance, Shippen Lewis, former Director of the Committee to Study Compensation for Automobile Accidents for the Columbia University Council for Research in the Social Sciences, financed by the Rockefeller Foundation, says:

> I believe that the controlling reason for this opposition is fear of state insurance. If every motorist must insure, will there not soon be a demand for an insurance fund conducted by the state. And if the state writes automobile liability insurance why not life, fire and accident insurance as well? It is natural and proper that this possibility should disturb those who make their living in the insurance business, but to the rest of us the argument does not seem so strong. Even though we believe that the state should keep out of the insurance business, we are willing to face that problem when it arises and are not so fearful of the future as to abstain from action simply because it may lead later to mistaken action. [158, *586*]

Although insurance interests now oppose compulsory insurance, they originally favored it. In fact, a prominent executive of one of the insurance companies drafted the original Massachusetts bill. Insurance companies favored the act until losses began accumulating. The accompanying table shows the loss experience of the insurance carriers in Massachusetts for the years 1927–1938.

It will be seen that the insurance underwriters lost in Massachusetts between 1927 and 1938 a total of approximately 12 million dollars or 8 per cent, although during this time the average premium rate increased 40 per cent. The greater part of this deficiency is due to losses during the first five years amounting to over $11,500,000, whereas losses for the last eight years were approximately $1,340,000. Thus since 1932 the provision for losses has been nearly adequate.

In spite of this gloomy picture a number of companies doing business in Massachusetts have made money consistently. They have kept their losses down by selecting their risks, by fighting fradulent claims, and by cutting the underwriting cost to the bone. As a result, however, of the strong companies picking their risks many owners have found difficulty in obtaining coverage. To care for this business a number of irresponsible mutual companies came into existence. Some of these companies were incompetently managed and eventually became insolvent, leaving many unpaid claims and unprotected customers. Altogether, 9 such companies were taken over by the courts and their affairs liquidated. Naturally all

TABLE 67

EXCESS OF LOSSES OVER PROVISION IN RATES UNDER THE MASSACHUSETTS COMPULSORY-INSURANCE ACT

(Compulsory coverage, all classes of motor vehicles, 1927–1938)

Policy Year	Losses Incurred	Provision for Losses in Rates	Excess	Percentage Excess
1927	$11,932,061	$9,938,048	$1,994,013	20
1928	12,987,640	9,885,803	3,101,837	31
1929	14,549,736	12,574,120	1,975,616	16
1930	16,728,425	13,786,158	2,942,267	21
1931	16,123,206	14,582,162	1,541,044	11
1932	14,757,630	15,361,225	603,595 [1]	4 [1]
1933	15,185,115	14,483,539	701,576	5
1934	17,522,014	15,024,593	2,497,421	17
1935	15,828,140	15,584,268	243,872	2
1936	14,610,783 [2]	16,307,109	1,696,326 [1]	10 [1]
1937	17,485,300 [2]	16,606,258	879,042	5
1938	15,221,341 [2]	15,731,486	510,145 [1]	3 [1]
Total	$182,931,391	$169,864,769	$13,066,622	8

1 Provision for losses exceeded losses.

2 Losses incurred developed. To losses incurred of $15,085,112, $18,072,661, and $14,896,802 for policy years 1938, 1937, and 1936 development factors of 0.9463, 0.9675, and 0.9808, respectively, were applied in the calculation of 1940 rates.

Source: Ralph H. Blanchard, *Revised Figures on Compulsory Automobile Insurance in Massachusetts,* May 23, 1940 (mimeo).

claims were settled at reduced values. Fortunately Massachusetts has come to realize the abuses committed by these irresponsible mutual companies and has made recommendations to correct the situation.

Another bad feature of Massachusetts compulsory insurance is the tendency for the number of claims to increase as shown by the table on page 216. Thus from 1927 to 1938 the claim frequency increased 33 per cent in Massachusetts and declined for the stock companies 21 per cent in the rest of the United States. Average cost per claim, however, declined 12 per cent in Massachusetts and increased 14 per cent elsewhere. The net result, however, of this increase of number of claims and decrease of cost per claim for the period of 1927 to 1938 was to increase the average loss cost per car of 12 per cent in Massachusetts as compared to a decrease of 11 per cent in the remainder of the country. Notice, however, that during the period 1930 to 1938 the average loss cost per

TABLE 68

BODILY INJURY LIABILITY INSURANCE FOR PRIVATE PASSENGER CARS

1927–1938, Inclusive

	Country-Wide except Massachusetts	Ten States	Massachusetts
	Per cent changes	*Per cent changes*	*Per cent changes*
Average cost per claim	+14 [1]	+18 [1]	−12 [2]
Claim frequency	−21 [1]	−24 [1]	+33 [2]
Average loss per car	−11	−10 [4]	+12 [3]

1930–1938, Inclusive

	Five States	Massachusetts
	Per cent changes	*Per cent changes*
Average loss per car	−27 [5]	−5 [3]

1 Stock company figures.

2 Stock and mutual figures. Compulsory coverage for 1927; compulsory and guest coverage on ways of Massachusetts for 1938 (commencing with 1936, guest coverage was eliminated from the statutory requirement).

3 Including complete guest and supplementary coverage.

4 California, Connecticut, Illinois, Missouri, New Jersey, New York, Ohio, Pennsylvania, Virginia, and Wisconsin.

5 Stock and mutual companies in New Hampshire, New York, North Carolina, Texas, and Virginia.

Source: Ralph H. Blanchard, *Revised Figures on Compulsory Automobile Insurance in Massachusetts,* May 23, 1940 (mimeo).

car in Massachusetts has decreased 5 per cent as compared with 27 per cent for 5 other states for which figures were available.

Probably the principal reason for the increase in claims in Massachusetts is the knowledge on the part of everyone (including lawyers) that the presence of insured cars affords a source from which money may be secured by carrying a "property damage claim to victory on the coat tails of a claim for nervous shock or for night sweats." [158, *596*]

The following table showing the large number of trivial losses paid indicates the aggregate importance of these minor claims.* Thus claims

* The few large claims that are paid is an indication of the relatively low value we place on human lives which have been snuffed out, and on serious injuries resulting from highway accidents. It also emphasizes the need of establishing more equitable minimum damages for the victims of accidents regardless of their ability to hire good lawyers.

totaling 31,566 were settled for less than $300 each. Such claims, the majority of which are settled out of court for their nuisance value, represent more than 89 per cent of all the claims of this character filed during the year in question.

The two features of the Massachusetts law as it now stands which are most objectionable to insurance companies are (1) the state's privilege of setting the premium rates and (2) the distribution of the bad risks.

TABLE 69

LOSS PAYMENTS TO OCCUPANTS OF OTHER VEHICLES
(Massachusetts, 1933)

Class Group	Fatal		Non-Fatal	
	Number of claims paid	Average costs	Number of claims paid	Average costs
Under $100	0	$ 0	18,226	$ 46
$100–$200	0	0	9,881	130
$200–$300	0	0	3,459	230
$300–$400	4	313	1,395	331
$400–$500	0	0	685	437
$500–$700	5	500	775	550
$700–$1,000	4	804	533	785
$1,000–$1,500	1	1,000	275	1,119
$1,500–$2,000	8	1,531	179	1,601
$2,000–$2,500	16	2,125	80	2,145
$2,500–$3,000	18	2,573	68	2,571
$3,000–$3,500	4	3,194	36	3,152
$3,500–$5,000	15	3,096	45	3,879
$5,000 and over	2	5,000	4	5,000
Totals	77	$2,322 (avg.)	35,641	$162 (avg.)

Source: R. J. Maloy, *An Analysis of the Massachusetts Compulsory Automobile Liability Insurance Act*, p. 7. Bureau of Motor Vehicles, Albany, N. Y.

The insurance companies would like to establish their own rates instead of having them set by the state insurance commissioner. They would naturally like to earn the same margin of profit they make in other states. Obviously, it would be to the best interest of all concerned to have the state and the insurance companies work out some agreeable compromise which would protect the interests of the motorists as well as of insurance companies. The fact that in recent years the provisions for losses approximates to the losses incurred indicates that such a compromise is being effectuated in Massachusetts.

As for bad risks, the insurance companies favor providing a "pool" in which the risks not accepted by any company would be placed. Such business would be written at a higher rate and all companies compelled to participate in this pool in proportion to their premium volume. The argument against the increase of rates for the poor driver is that the strong should carry the weak, especially since negligence is difficult to determine because of the usual lack of sufficient evidence. Often both parties are partly to blame, and sometimes the accident results from a combination of circumstances which are beyond the control of either party. But regardless of the difficulty of assessing equitably different rates for poor risks, it is generally agreed that bad risks must be distributed fairly among the different companies. To solve this problem an assigned risk plan under which many of the persons who are denied insurance are assigned to carriers operating in Massachusetts, has been put in operation. This plan reduces the number of complaints to the Board of Appeal and the criticism of the insurance carriers.

Summarizing the argument for a form of compulsory insurance which pays damages regardless of fault, Shippen Lewis writes:

> Every motorist should be required to insure against his liability for personal injuries and death, because experience shows that this is the only way to protect the public. If the state is to control the premiums, the political mistakes of Massachusetts must be avoided. For automobile accidents, a system of compensation without regard to fault, administered like workmen's compensation, would be better than the present system of liability for negligence only; because it is no longer realistic to apply the negligence test to automobile accident compensation; because such a system would more fairly distribute losses, particularly in serious cases; because payments would be prompter; and because the courts in the large cities would be relieved of a mass of litigation which is no longer suited for jury trial.* The most serious problems are to estimate the cost of premiums, to prevent the fixing of premium rates from becoming a political issue, and to minimize fradulent claims especially by nonearners. [158, *597*]

Unquestionably public interest requires adequate financial protection against the consequences of automobile accidents. Eventually some system of compulsory insurance either by private insurance companies or through a state fund will undoubtedly be worked out which will satisfactorily compensate victims of automobile accidents regardless of negligence or the assets of the parties involved, and overcome the shortcomings of present-day financial-responsibility and compulsory-insurance laws.

* For an illuminating discussion of the congestion in the Massachusetts courts and suggestions for curing it see an article by Dunbar F. Carpenter. [47]

SOLVING THE PROBLEM OF INCOMPETENT AND IRRESPONSIBLE DRIVERS

Research reveals that there is a small group of drivers who over a period of a few years accumulate as much as one-third to one-half of all accidents. Young inexperienced operators in their "teens" have more accidents in proportion to the number licensed, and in proportion to their miles of travel, than older experienced drivers; but since it takes time to build up a record and become a repeater, mature experienced drivers having longer records naturally constitute the bulk of the repeaters.

Accident repeaters are more likely to be involved in future accidents than are drivers with clear records. They are often chronic traffic violators, and the more violations they have the more personal injury accidents they tend to be responsible for.

Once accident-prone * drivers are detected, they can be regulated, but it will take much better automobile accident reporting and recording than we have at present to keep adequate check on them. A besetting weakness of our present system of driver control is that most states do not have adequate accident reporting and do not keep permanent easily accessible records of all accidents and violations. If this situation is remedied, however, and all repeaters are segregated and identified, they can either be cured or controlled by some of the methods discussed in Chapter XIV, or else removed from the road by suspension or revocation of their licenses.

As for protecting the innocent victims of financially irresponsible drivers, the most foolproof system at present seems to be some type of compulsory insurance. Since there is little evidence to show that either financial-responsibility or compulsory-insurance laws serve to reduce accidents, however, it would be better if legislators would limit their debate on these measures to the benefits to be derived in compensating victims of automobile accidents. The laudable enthusiasm for the supposed safety aspects of these laws on the part of legislators and insurance officials might very profitably be redirected toward helping state officials improve the methods of training, examining, and controlling drivers as outlined in Chapters XIII and XIV, which latter measures have unquestioned value in reducing accidents.

* O. W. Wilson, Professor of Police Administration at the University of California, says: "Every dog has his bite and every driver his accident. A second bite classifies a dog as vicious. A second accident classifies a driver as accident-prone." [292, *13*] Wilson's statement seems adequately to define an "accident-repeater" rather than an "accident-prone" driver. I believe the term "accident-prone" should be reserved for drivers who have had three accidents, and whose accident rate per mile driven and responsibility for accidents incurred indicate lack of normal skill and safety-mindedness. Certainly agreement on some definition is necessary, and more research on causes of accident-proneness is desirable as a foundation for developing equitable regulations for the control of drivers who incur accidents.

CHAPTER X

PEDESTRIANS

DEVELOPMENT OF THE PEDESTRIAN ACCIDENT PROBLEM

About one-third of the people killed in automobile accidents in the United States are pedestrians. [201, *84*] To an understanding of the general problem of motor vehicle accidents, therefore, an understanding of pedestrian accidents is basic.

First let us see whether pedestrian accidents have been increasing or decreasing. Estimates as to the number of persons killed in various types of automobile accidents were first made about 1927. From that date pedestrians accidents showed an increase in number, reaching a peak in 1937. After that, in 1938, 1939, and 1940, however, the number of pedestrians killed was much lower than in preceding years, falling to approximately the 1930 level.* [201, *82*]

Urban and rural pedestrian deaths have not paralleled each other. Since 1930 pedestrian deaths have increased considerably in rural areas, whereas in urban areas they have decreased. In 1930 pedestrian deaths in cities of more than 10,000 population accounted for about two-thirds of all pedestrian deaths. By 1940, however, urban deaths had been lowered so much and pedestrian deaths in small towns and rural areas had increased to such an extent that the number of pedestrians killed in cities of over 10,000 population and in rural areas and cities of under 10,000 population was the same. [201, *83*]

GEOGRAPHICAL DISTRIBUTION OF PEDESTRIAN ACCIDENTS

The pedestrian accident problem varies greatly in importance in different states. In some states pedestrian fatalities are far outnumbered by deaths to occupants (drivers and passengers) of vehicles. In other states pedestrian deaths represent a majority of all the deaths resulting from

* We are speaking here of the *actual* number of pedestrians killed, not of the ratio of pedestrian fatalities to the number of operators, cars, or vehicle-miles driven. Although the ratio of pedestrian fatalities to these three factors, which have been increasing, has declined, there have been no fewer pedestrians killed.

TABLE 70

RELATION OF PEDESTRIAN FATALITIES AND PEDESTRIAN PERSONAL INJURIES TO ALL AUTOMOBILE FATALITIES AND INJURIES BY STATES (1939)

	Pedestrian Fatalities	Pedestrian Injuries
	Per cent	*Per cent*
Rhode Island	66.7	31.7
Massachusetts	56.8	21.4
Connecticut	52.0	19.0
New Jersey	51.8	24.3
Pennsylvania	50.4	23.1
New York	50.2	32.5
West Virginia [1]	47.0	18.7
Illinois	43.8	22.5
Kentucky	43.4	12.4
Maine	43.1	....
California	37.4	16.6
Washington	36.7	16.4
Tennessee	36.0	21.4
Maryland [2]	35.8	11.3
New Hampshire	35.6	15.9
Louisiana	35.3	15.2
North Carolina	35.1	14.2
Michigan	34.4	25.4
Oregon	33.6	17.6
Utah	33.3	14.0
Virginia	33.2	16.1
South Carolina	32.5	7.8
Arkansas	32.2	9.9
Vermont	32.1	15.7
Kansas [3]	31.2	....
Colorado [1]	31.1	14.7
Minnesota	31.0	16.3
Georgia	28.0	11.4
Oklahoma	25.3	9.0
Texas	24.3	12.1
Indiana	22.8	12.9
Iowa	22.1	11.7
Arizona [1]	22.0	10.5
Missouri [4]	20.8	3.7
Idaho [1]	20.8	5.6
Delaware [5]	19.7	7.7
North Dakota	18.4	15.4
Ohio [6]	18.4	3.6
Nebraska	17.3	11.0
Nevada	13.0	2.0
South Dakota	8.8	9.6

1 1938. 2 Excludes Baltimore. 3 1935. 4 State highways only. 5 Excludes Wilmington. 6 Rural state highways only.

Source: Annual state statistical reports of motor vehicle accidents, 1939.

motor vehicle operation. A variety of factors bring about these differences.

Highly urbanized, thickly populated states account for the great bulk of pedestrian fatalities in this country, as seen in Table 70 on page 221, which shows, where this information is obtainable, the extent to which pedestrian fatalities and injuries contributed to total automobile deaths and injuries in those states in 1939. Injuries to pedestrians do not, of course, bulk so large as pedestrian fatalities, because of the extremely high ratio of deaths to injuries in this type of accident.

Note in the first column that pedestrian fatalities are high in proportion to occupant deaths in densely populated states where a large proportion of the people live in cities—Rhode Island, Massachusetts, Connecticut, etc.—and are low in rural states—South Dakota, Nevada, Nebraska, etc. This is primarily because of the concentration of pedestrians and vehicles in urban communities in the first group as opposed to the sparse pedestrian traffic in states in the second group.

Density of population, irrespective of the extent of urbanization, is a factor of importance here. Even though a state is predominantly rural in character, pedestrian fatalities will be high if the rural areas of the state are thickly settled. This point can be illustrated by a comparison of the ratios of pedestrian fatalities to all automobile fatalities in Oregon and South Carolina where annual motor vehicle travel is about the same. In Oregon, which is 51.3 per cent urbanized [49, *7*], pedestrian deaths amounted to 33.6 per cent of the total motor vehicle deaths in that state in 1939. In South Carolina, on the other hand, although only 21.3 per cent of the people live in urban communities, 32.5 per cent of those killed in motor vehicle accidents were pedestrians. The high density of population, 57 persons per square mile in South Carolina [49, *3*], compared with that of Oregon, which has only 10 persons per square mile, undoubtedly helps to explain why the pedestrian fatality rate in South Carolina is so high in spite of low urbanization.

RURAL VERSUS URBAN PEDESTRIAN FATALITIES

Although the pedestrian problem is still primarily an urban problem the importance of rural pedestrian fatalities should not be minimized. Rural pedestrian fatalities in recent years have increased greatly in number. Urban fatalities, in contrast, have declined considerably. At present, one-third of all pedestrian fatalities result from accidents occurring in rural areas, whereas two-thirds follow those accidents happening in cities and towns.* [201, *83*] Since over two-thirds of motor vehicle travel

* Cities and towns in this instance include all incorporated areas, not merely those of over 10,000 population.

takes place on rural roads (see Chapter II, p. 16) the likelihood of killing a pedestrian in rural areas would seem to be about one-fourth as great per mile of travel as in urban areas.

A recent study of the pedestrian problem in Pennsylvania, on the other hand, shows that although many more pedestrians were killed in 1939 in urban areas than in rural areas, the death rate per population in rural areas was more than twice that of large cities and three times that of small cities.

TABLE 71

COMPARISON OF PEDESTRIAN DEATHS PER POPULATION IN URBAN AND RURAL AREAS

(Pennsylvania, 1939)

	Population	Per Cent of State Population	Pedestrians Killed	Per Cent of Pedestrians Killed in State	Pedestrian Deaths per 100,000 Population
Cities or boroughs 100,000 population and over	2,991,349	31.1	270	27.9	9.0
10,000 to 100,000	2,205,942	22.9	168	17.3	7.6
Under 10,000	2,255,686	23.4	138	14.2	6.1
Total all cities	7,452,977	77.4	576	59.4	7.5 (avg.)
Rural	2,178,373	22.6	394	40.6	18.1
State	9,631,350	100.0	970	100.0	10.2 (avg.)

Source: From *Motor Vehicle Traffic Accidents, 1939; The Pedestrian,* p. 4. Bureau of Highway Safety, Harrisburg, Pa.

Although accident statistics show that collisions of vehicles increase with congestion, pedestrian fatalities are less common at busy intersections in the heart of the city where pedestrians are most numerous than in less congested urban areas. In crowded downtown areas automobiles slow down and drivers are more watchful because of the more confusing traffic. Pedestrian fatalities occur more commonly at widely scattered points in residential areas.

Of the pedestrians killed on rural highways the majority are walking along the roadway or crossing it during hours of twilight and darkness, and in general tend to walk with their backs to cars approaching on the same side of the road. In South Carolina in 1940, 10 pedestrians were killed on rural highways facing traffic, as against 19 with their backs to traffic. A check of the habits of South Carolina pedestrians on rural high-

ways showed that 80 per cent walked facing traffic, as recommended by state law and enforced by state police, as against 20 per cent walking with their backs to traffic. [265, *56*] The fatality rate of the small proportion of pedestrians walking with their backs to traffic was therefore exceedingly high. The reasons for the low rate of the pedestrian facing traffic are that he is more visible to motorists (who can see his face and hands if he has on dark clothes) and is better able to step off the paving before he is hit.

INFLUENCE OF AGE ON PEDESTRIAN ACCIDENTS

The likelihood of pedestrians being killed varies according to their age.

Numerical Trend in Adult and Child Pedestrian Deaths

A comparison of pedestrian deaths in New York State in 1937 with those in 1927 shows that fatalities involving children under 5 years of age decreased 30 per cent in the intervening period, while deaths of chil-

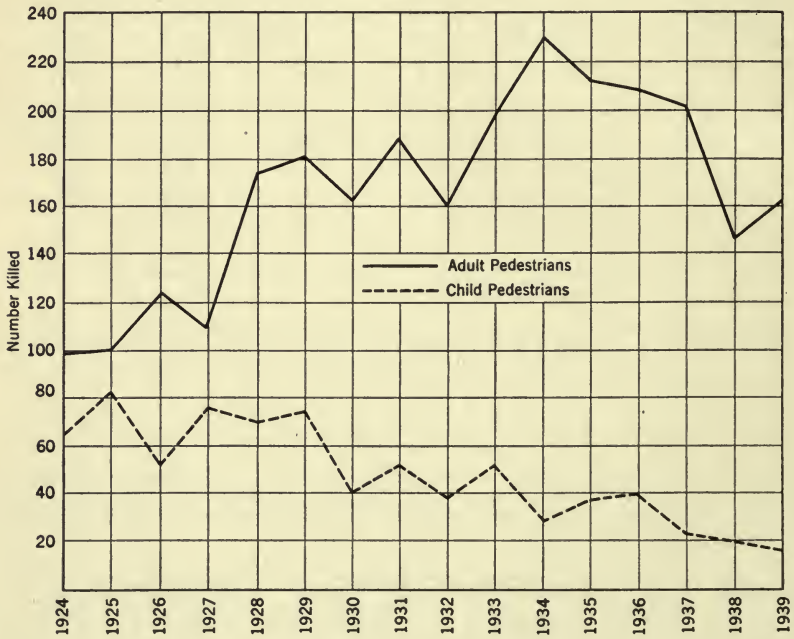


Fig. 39. Trend of adult and child pedestrian fatalities (Connecticut, 1924–1939). Source: 1924–1938, *Connecticut's 1938 Pedestrian Fatalities*, 1939; *Traffic Topics*, April, 1940, Department of Motor Vehicles, Hartford, Conn.

dren 5 to 14 years old decreased 50 per cent. [214] Fatal accidents in which children playing in the street were involved showed a decrease of 75 per cent. In contrast, pedestrian fatalities of persons 15 years of age and over showed a 50 per cent increase. Thus although the record of children has markedly improved, the record of adult pedestrians has grown steadily worse. The improvement among young people can be attributed in part to the training in safety education received in the schools.

This fact is clearly demonstrated in a study of child pedestrian deaths in Massachusetts before and after safety education instruction was begun in the public schools. Immediately after the inauguration of such courses the number of child deaths in Massachusetts dropped rapidly and the trend has been downward ever since. From a high point of 227 in 1924, child pedestrian deaths were reduced to 74 in 1939, despite the fact that the number of licensed operators doubled during these years. The state's adult pedestrian deaths, however, continued to rise steadily year after year until quite recently, when a substantial drop was recorded. [171]

The preceding figure shows clearly the downward trend in child pedestrian fatalities in another state, Connecticut. Deaths of adult pedestrians are seen to be considerably more numerous today than in 1924 (although somewhat less frequent than they were at the high point in 1934), whereas child pedestrian deaths were less than one-third as common as they were in 1924.

Ages of Pedestrians Killed

Figure 40 on page 226 shows that 70 per cent of the pedestrians killed in automobile accidents in Connecticut are 40 years of age or older.

There are several reasons why so many middle-aged and elderly pedestrians are involved in pedestrian fatalities. One is that persons who are middle-aged and older today grew up before the automobile had become an important street hazard. They had no opportunity to learn to dodge traffic during their plastic years.

A second reason is that elderly people have not adjusted their manner of walking on the highways to their failing ability to see and react quickly. They take advantage of their age, assuming that drivers will defer to them. But the very fact that older persons cannot see so well nor move so fast is the reason why they need to exercise more than ordinary caution in crossing streets.

Further, older people are much more likely to die of injuries received when struck by an automobile than are younger people. Figures from one state show that a pedestrian over 50 has only one-half as much chance of recovering from such an injury as one under 20. [225]

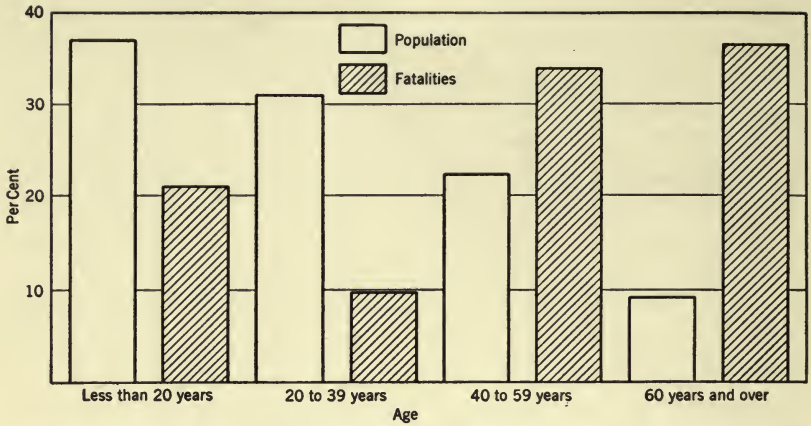


FIG. 40. Age distribution of pedestrian fatalities for five-year period, 1932–1936, compared with age distribution of the population, 1930.

Source: Fatalities: *Further Statistical Comment on 1238 Pedestrian Fatalities in Connecticut, 1932–1936, Inclusive*, p. 10 (mimeo). Department of Motor Vehicles, Hartford, Conn.

Population: *Age Distribution* (Reprint of p. 616, Chapter 10, Vol. II, Fifteenth Census Report on Population), Bureau of the Census, U. S. Government Printing Office, Washington, 1933.

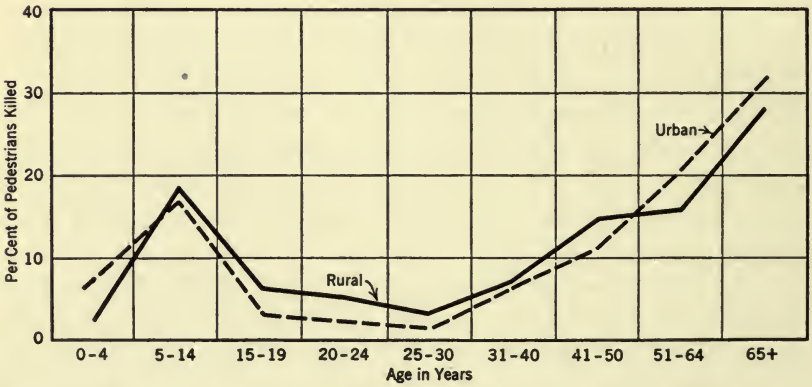


FIG. 41. Percentage distribution of ages of pedestrians killed in urban and rural areas (Pennsylvania, 1939).

Source: Figures derived from *Motor Vehicle Traffic Accidents, 1939; The Pedestrian*, p. 12. Bureau of Highway Safety, Harrisburg, Pa.

The increase in night driving in recent years has also undoubtedly increased the hazards of adult pedestrians since the great majority of walkers on the road at night are adults, many of whom have never driven a car, and who are therefore ignorant of the difficulties drivers have in seeing them in time to stop.

Analysis of figures gathered in a recent study in Pennsylvania shows that the proportions of pedestrians of different ages who are killed by automobiles do not vary greatly in urban and rural regions. Notice in Figure 41 that persons over 40 are the chief victims of automobiles in

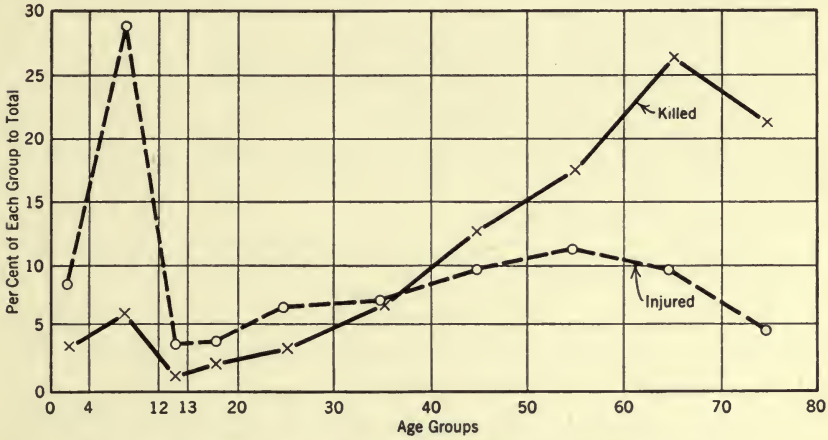


Fig. 42. Pedestrian accidents by age groups (Connecticut, 1939).
Source: Figures derived from Connecticut Department of Motor Vehicles, *Statistical Report, 1939.*

both rural as well as urban areas, with children between the ages of 5 and 14 coming next. The very young and very old rural dwellers are slightly less likely to be killed than urbanites of the same ages.

Ages of Pedestrians Injured

Although elderly people present the main problem in the pedestrian *fatality* situation, children between the ages of 5 and 14 contribute a disproportionate share of pedestrian *injuries.* As will be seen in Figure 42 showing pedestrian accident data from Connecticut, children from 4 to 12 years have by far the highest pedestrian injury rate. It is plain that the problem of keeping children from being injured by motor vehicles is still a long way from being solved, although we have made considerable progress in lowering their pedestrian death rate.

Ages of Operators Involved in Night Pedestrian Accidents

Although the pedestrians in accidents at night are largely older persons, they are hit by young drivers. The figure below shows that a much larger percentage of drivers in night pedestrian accidents in one state are in younger age groups than would be expected from the distribution of licensed drivers by ages. The motorists incurring pedestrian accidents

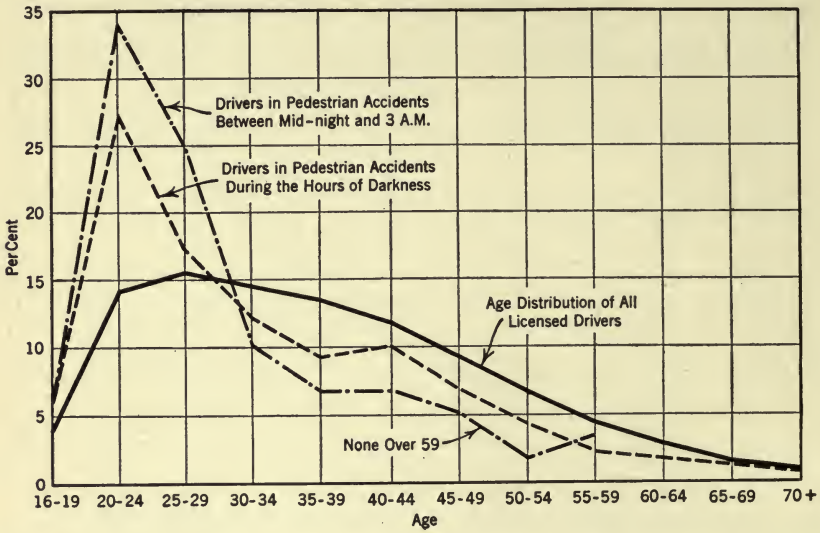


Fig. 43. Percentage distribution by ages of drivers in night pedestrian accidents (Connecticut, July–December, 1938).

Sources: Figures derived from *Statistical Summary of Accidents, 1938.* Department of Motor Vehicles, Hartford, Conn.

between midnight and 3 A.M. are even more predominantly young drivers. Over 65 per cent of those hitting pedestrians during these hours are under 30 years of age. Night traffic probably includes a large percentage of young drivers, which may account for their greater participation in night accidents, but figures as to the ages of night drivers are not available.

SEX DIFFERENCES IN PEDESTRIAN ACCIDENTS

Men are much more frequently killed in pedestrian accidents than are women. However, the ratio of almost four male deaths to one female death is quite similar to the ratio of male-female deaths in non-pedestrian fatal accidents.

The ratio of men to women injured in pedestrian accidents is lower, being close to two males for each female.

The excessive proportion of male pedestrian fatalities when compared with that of male pedestrian injuries probably results from the greater activity of men during dangerous hours after dark when the ratio of pedestrian fatalities to injuries is high.

TABLE 72

SEX OF PEDESTRIANS KILLED AND INJURED
(Twenty-one states, 1940)

	Pedestrians Killed		Pedestrians Injured	
	Male	Female	Male	Female
	Per cent	*Per cent*	*Per cent*	*Per cent*
Average, 21 states	79.8	20.2	68.2	31.8

Source: Annual statistical summaries of the following states: Ala., Ariz., Ark., Ga., Ida., Ind., Ia., La., Mass., Minn., Neb., N. J., N. D., Okla., Oreg., Tenn., S. C., Tex., Utah, Va., Wash.

THE TIME FACTOR IN PEDESTRIAN ACCIDENTS

Pedestrian accidents do not occur uniformly throughout all months of the year, days of the week, or hours of the day.

MONTHLY PEDESTRIAN FATALITY RATES

Adult pedestrian deaths are strongly influenced by seasonal factors. The fall of the year invariably sees a great increase in them, as Figure 44 shows clearly. Child pedestrian deaths, as the chart reveals, are distributed more uniformly throughout the year, although for children the summer months seem to be somewhat more dangerous than other periods.

The enormous increase in adult pedestrian deaths in the fall of the year may be traced to several factors. The most important of these is the decrease in the hours of daylight during these months. Gradually, as the year advances, the period of heavy pedestrian traffic between five and eight o'clock in the evening is shifted from daylight to dark. The restricted visibility which results from this and from poorer weather conditions, such as sleet and snow, is the basic cause of increased pedestrian casualties during these months.

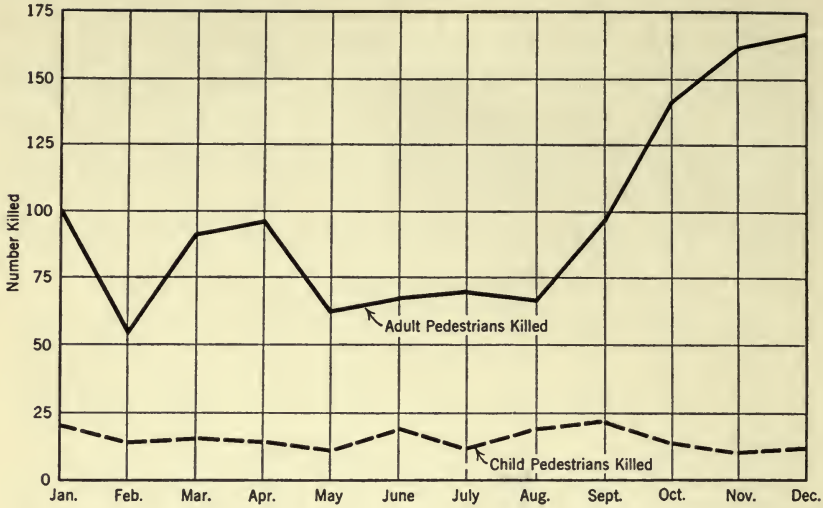


Fig. 44. Adult and child pedestrians killed by months (Connecticut, 1934–1939).
Source: Figures derived from *Traffic Topics*, April, 1940; *Connecticut's Pedestrian Accident Experience, 1939.* Department of Motor Vehicles, Hartford, Conn.

Daily Pedestrian Accident Rates

Friday and Saturday are the days on which pedestrian accidents are most common. Saturday heads the list, with Friday not far behind. Sunday stands after Saturday in fatal accidents.

TABLE 73

Pedestrian Accidents by Days of the Week
(Pennsylvania, 1939)

Day of Week	Fatal	Non-Fatal	Total
	Per cent	*Per cent*	*Per cent*
Sunday	15.8	11.5	11.8
Monday	13.0	14.8	14.7
Tuesday	11.2	13.2	13.1
Wednesday	12.3	13.0	12.9
Thursday	10.4	13.2	13.0
Friday	14.8	15.3	15.3
Saturday	22.5	19.0	19.2
Total	100.0	100.0	100.0

Source: *Motor Vehicle Traffic Accidents, 1939: The Pedestrian,* p. 14. Bureau of Highway Safety, Harrisburg, Pa.

A study of rural pedestrian accidents made by the Virginia Division of Motor Vehicles in 1939 [283], showed that 112 pedestrian accidents (22

per cent of the weekly total of 500) occurred on Saturday night or early Sunday morning. Forty-five (25 per cent) of the 180 pedestrian fatal accidents took place during this period. Saturday night was about four times as deadly as the average of the rest of the nights of the week. The receipt of the Saturday pay check and more drinking by both pedestrians and drivers on Saturday night and early Sunday morning are undoubtedly important factors in explaining the high accident rates on the week end.

Pedestrian Fatalities by Time of Day

Figure 45 shows that the great majority of pedestrian fatalities occur during hours of darkness. The reason is that adults, who form the bulk

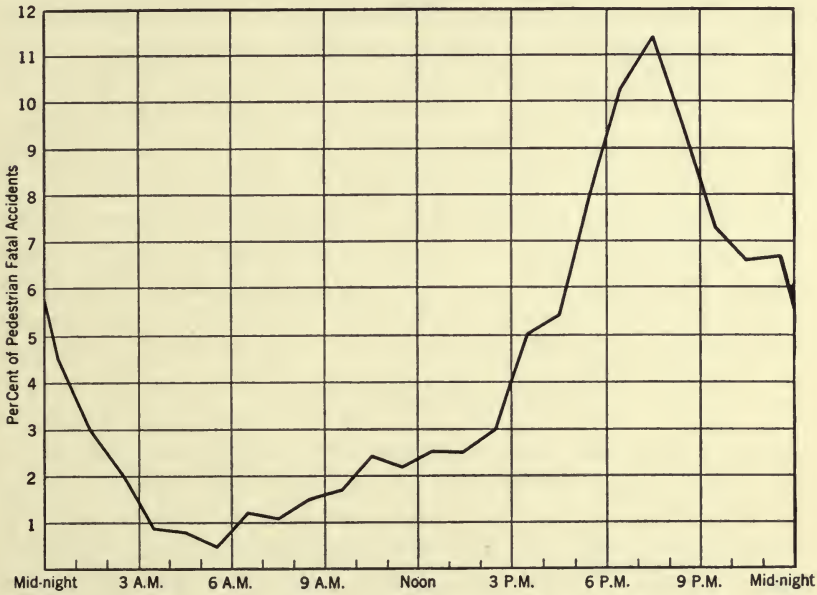


Fig. 45. Fatal pedestrian accidents by hours of the day (seven states, 1939).
Source: *Accident Facts*, 1940 Edition, p. 88. National Safety Council, Chicago, Ill. Based on reports from seven state traffic authorities.

of pedestrian fatalities, are killed chiefly at night. In Connecticut, almost half the total pedestrian fatalities in 1939 occurred during the dark hours of October, November and December. [58]

Child pedestrian fatalities occur chiefly in the daytime and, as was stated earlier in the chapter, at about the same rate during all months of the year, with slight increases frequently reported in the summer.

TYPES OF PEDESTRIANS INVOLVED IN ACCIDENTS

Research reveals that factors such as ownership of a driver's license, socio-economic condition, race, and intoxication influence a pedestrian's susceptibility to accidents.

Majority Not Motor Vehicle Operators

Studies made of pedestrian deaths in Connecticut during the years 1932–1939 show that of the 1,537 pedestrians killed who were eligible to drive a car (i.e., at least 16 years of age) just 77, or 5 per cent, were licensed operators. Ninety-five per cent of the pedestrians killed were non-operators who, presumably, knew little about the operation of a motor vehicle. They were ignorant of the difficulty of seeing pedestrians at night or during a storm, of stopping suddenly when traveling at a high speed. [58] Had they ever learned to drive a car, many of them would have developed a realization of the danger of the road which would have made them more cautious about getting in the way of motor vehicles and might have saved their lives.

Several other states which have made checkups of the number of adult pedestrians killed who had drivers' licenses, have obtained results paralleling those of Connecticut. In Pennsylvania, for example, of 763 pedestrians of legal driving age who were killed, only 1.7 per cent were drivers. [225]

Influence of Residence

A study of the residences of pedestrians killed in Washington, D. C., over a five-year period shows that one-third of all those killed came from five sections representing only about 9 per cent of the total residential areas of the city. [16, *18*] These five areas include an excess of persons of low economic and educational status. Studies in Hartford, Connecticut; Portland, Oregon; and Cleveland, Ohio, also reveal that well-defined areas and groups contribute disproportionately to the pedestrian accident problem.

Influence of Race

According to the meager information available on the subject, races appear to differ somewhat in their susceptibility to pedestrian accidents. A pedestrian accident survey in Dallas, Texas, showed that over a period of three years white persons, representing 82.9 per cent of the population, had 76.2 per cent of the fatalities, whereas negroes, who constituted 14.8

per cent of the population, accounted for 19.3 per cent of them, and Mexicans, forming 2.3 per cent of the population, suffered 4.6 per cent of the fatalities. [69] In other words, in proportion to their numbers, the whites had the best record; the negroes, the next best; and the Mexicans, the worst. In general, pedestrian accidents were found to occur more often in the lower-income fields.

Influence of Intoxication

In recent years considerable emphasis has been placed on the role of the drunken driver in traffic accidents. Studies have been made to determine the extent of drunken driving, and the intoxicated driver has been singled out as an object of attention in enforcement drives. All this has had beneficial results. The drunken driver has come to be regarded in the public mind as a most dangerous traffic offender. Stiff penalties are quite commonly imposed by the courts and driver license bureaus upon drivers convicted for this offense.

Perhaps because of the fact that a drunken pedestrian usually inflicts damage on no one but himself the role played by the drunken pedestrian in traffic accidents has received far less attention. Recent studies have shown, however, that the pedestrian who is killed is frequently the pedestrian who has been drinking.

Tests made in New York City over a three-year period revealed that of a group of 814 pedestrians killed in motor vehicle accidents, 33 per cent had a concentration of alcohol in the brain tissue sufficient to warrant the conclusion that they were under the influence of alcohol. [202, 7] A similar study by the coroner of Cuyahoga County, Ohio, revealed that about 45 per cent of a group of 134 persons killed while walking on the highway had more than 0.1 per cent of alcohol in the body fluids, an amount regarded as marking the borderline of intoxication.

In a Connecticut study the highest incidence of intoxication among pedestrians in accidents was found to be between the ages of 40 and 49. [55] Additional studies of the ages of intoxicated pedestrians in accidents would be most valuable.

The intoxicated pedestrian is a potential casualty on the automobile accident front over which the state has seemingly little control. Motor vehicle authorities are agreed that in controlling drunken pedestrians, so far not even a good beginning has been made. Probably the most effective acceptable means of keeping them out of the road would be to give the police authority to remove at once to his home any intoxicated person seen on the streets.

PEDESTRIAN RESPONSIBILITY

Contrary to the opinion that has long been held, pedestrians are to blame in the majority of the accidents in which they are involved. In a recent analysis of accidents in Connecticut it was found that blame for a total of 923 fatal pedestrian accidents was attributed to pedestrians, although in only 315 cases was it attributed to the operator after extensive police investigation. In other words, 75 per cent of the accidents were blamed on the pedestrian. [58] Coroners' verdicts, after formal examination, placed the blame on the operator in only 14 per cent of all the inquests held over pedestrian fatalities occurring in Connecticut in 1939. Even taking into account the fact that dead pedestrians can't talk, pedestrian guilt is evident.

Studies made in New York State indicate that negligent acts of the pedestrian contributed to three out of every four personal injury accidents in which he was involved, and to three out of five of his fatal accidents. [215] In Pennsylvania pedestrians were deemed responsible for 70 per cent of the fatal accidents in which they were involved. [225]

Findings such as these are beginning to have a beneficial effect in reorienting public opinion. When the outworn notion that the motorist is always to blame is dispelled and the responsibility for pedestrian accidents placed where it belongs, on the pedestrian, the pedestrian accident problem will be on its way to a solution.

THE QUALIFICATIONS OF A GOOD PEDESTRIAN

Having discussed the types of pedestrians who get into accidents, it may be illuminating for us to approach the problem from another angle and point out the characteristics of *safe* pedestrians.

Respect for the Dangerous Potentialities of the Motor Car Reflected in Intelligent Walking Habits

The safe pedestrian, realizing that he occupies a completely unprotected position on the road, that between him and approaching tons of steel there is nothing but the flick of a driver's wrist, conducts himself accordingly. He avoids walking along the pavement of a busy highway, particularly after dark or in stormy weather, and if circumstances compel him to take this risk, he walks *facing* oncoming cars and steps off the road to let them pass. At night he carries a flashlight or lantern to warn drivers of his presence, or wears a reflector button. When he crosses

the highway he does so deliberately and cautiously, in recognition of the fact that he constitutes an interference with the forces which, whether he likes it or not, control the road.

In the city he does not jaywalk or cross against the light, knowing that many who have done so have long since repented of their folly. Regarding cars as a potential threat to his life and limb, he accords them respect and does not carelessly trespass on their domain.

Realization of the Difficulty of Speed and Space Estimation

An understanding of the unreliability of speed and space estimation is another characteristic of the safe pedestrian. It is hard to judge by a quick glance at an oncoming car whether you will have time to cross a street; the average person's estimation of relative distances covered at different speeds is quite faulty, and that of older people who have not had the training supplied by driving a car is especially so. To make up for this lack, the careful pedestrian is sure to allow an extra margin of space between himself and the approaching car.

Reliable Vision

Also the ideal pedestrian has had his eyes examined, and taken steps to correct whatever defects were found to be present. We have no records to show just what part impaired vision plays in pedestrian accidents, but it is no doubt considerable. After the age of 40 even those who have had normal eyesight before usually suffer from some sort of visual defect. Visual defects are quite common after that age, as is night blindness, both of which multiply the hazards of walking on the highway.

Also dangerous for the person on foot are defects which cause impaired perception to the side, such as "tunnel vision" and binocular suppression (see Chapter IV). Persons with these handicaps often do not realize their weaknesses and may be run down by a car approaching from the side before they are aware of its approach. Tunnel vision and binocular suppression can be detected by an eye specialist. Once known they can be compensated for by frequent turns of the head and alternation of the gaze from one side to the other.

Adequate Hearing

Hearing is more valuable to the pedestrian than to the motorist. When on foot we are often made conscious of the approach of cars only through our sense of hearing, which warns us to look up and get out of the way.

Defects in hearing are especially common among older people and account for many pedestrian accidents involving them, for unfortunately, pride and habit make many elderly persons neglect to adjust their manner of walking to their reduced sensory ability. Deaf persons must remember to be especially alert *visually* to traffic. If they have poor hearing on only one side, they should make up for it by being especially observant on that side.

THE INARTICULATENESS OF THE PEDESTRIAN

American pedestrians are comparatively unorganized and voiceless. To be sure a National Pedestrians' Association has recently been formed in this country but it has attracted little support and has up to the present exerted a negligible influence. In England, on the contrary, there has been a vigorous Pedestrians' Association since 1929. [281, *134*]

There are many things that a pedestrians' organization could do in this country. First of all, it could act to offset the tremendous lobbying influence of organizations representing the motorist. Although there is and should be no group disagreement between motorists and pedestrians, nevertheless the inarticulateness of the pedestrian has resulted in a neglect of his interests in the traffic improvements that are constantly being made. For example, the timing of traffic lights is frequently done without regard to the convenience of pedestrians. And when streets are widened or new boulevards laid out, often insufficient provision is made for protecting pedestrian crossings.

The Pedestrians' Association in England publishes a news letter, an excellent way to reach older people and acquaint them with problems connected with the reduction of accidents involving pedestrians. It also investigates pedestrian deaths and advocates measures for promoting the safety of pedestrians such as forcing cars to keep within a reasonable speed limit and providing properly marked crossings on highways.

SUGGESTED REMEDIES FOR THE PEDESTRIAN PROBLEM

Remedies suggested for pedestrian accidents are of four types, which stress, respectively, (1) legislation, (2) enforcement, (3) engineering, and (4) education.

Legislation

Because of the historical priority of the pedestrian he has been accorded special privileges on the highways. Relatively few laws limit

the rights of pedestrians in contrast to the many regulations in the statute books limiting the rights of motorists.

This lack of definition of the prerogatives of the pedestrian has led to much disagreement about the respective rights of motorists and pedestrians on the road. Perhaps, as William J. Cox, Connecticut State Highway Commissioner, maintains, the best way to clarify the situation would be to give the motor vehicle preferred status on the roadway, and the pedestrian priority on the sidewalk. [64]

The greatest source of interference comes at intersections. A crosswalk at an intersection, according to Cox, is really a *sidewalk.* According to his way of thinking, although, as is generally the rule now, a pedestrian at a crosswalk would take precedence and the motorist would have to concede him the right of way, between intersections the *motorist* would have the right of way, and the pedestrian would not have the right to enter the road there except when he could do so without interference with a motor vehicle. In other words, a person who was struck by an automobile while crossing a street in the middle of the block could not validly claim that he had as much or more right to the road at that point than the motorist.

We need some such law as this to define adequately the preferential rights of motorist and pedestrian so that both can be sure as to which parts of the road they are entitled. Uniform legislation should be passed punishing jaywalking and placing the responsibility squarely on the motorist to protect the lives of pedestrians at crossings and on the pedestrian to keep out of the motorist's way at other points. At present, in the case of injury to a pedestrian, the law tends to protect him and to punish the motorist, regardless of how dangerous the pedestrian's actions may have been.

Enforcement

The second field for improvement in dealing with pedestrians is that of the enforcement of existing traffic laws protecting them. Police departments must see to it that such rules are obeyed, for obviously regulations are of no avail if disregarded.

Speed limits, especially in crowded sections, must be enforced and drivers held if they do not allow pedestrians the right of way at intersections. Traffic officers must also check occasionally on the observation of traffic signals, which, experience has shown, will not otherwise be consistently obeyed. Penalties must be inflicted for neglecting stop signs or for passing street cars from which passengers are alighting.

To ensure that motorists allow school pupils to cross in safety, school crossings should be protected by a policeman on duty at the opening and

close of school. At some schools a schoolboy patrol has proved to be of great assistance. Older boys, especially chosen, are delegated to assist the policeman by superintending the crossing of pupils at neighboring intersections and in some cases are even empowered to stop traffic at their corners.

Engineering

A number of engineering improvements have been developed which make the streets safer for pedestrians. Among these are traffic lights timed to allow pedestrians enough time to cross the street; safety zones protected by elevated islands or markers; chain barriers or rails to prevent people from crossing the middle of busy city blocks (used with success in New York City, Providence, and Albany), overpasses or underpasses at schools or especially busy intersecting streams of automotive and pedestrian traffic; improved street lighting, which has proved to be very effective; and rural sidewalks. A wider use of these protections is needed, while still more road engineering aids are indicated.

Education

The need for educating pedestrians is revealed by the fact that pedestrians who are killed are seldom drivers and apparently know little about the dangers of walking on the highways.

The question of how to educate adult pedestrians is a difficult one; there is no one special agency through which safety education can be brought to them. They are admittedly hard to reach, but since they, especially the elderly ones, are responsible for the highest percentage of pedestrian fatalities, no program for the saving of pedestrian life on the highway can possibly be adequate until it touches them. Various agencies such as churches, benevolent groups, safety organizations and life insurance companies are distributing information in print and on the air about safe walking. Articles are being disseminated through the newspapers. Police in some localities are instructed to spend a certain amount of their time warning pedestrians of dangerous actions and talking to them of proper pedestrian behavior—South Carolina has employed this plan in rural districts apparently with good results. But the fact that the total of pedestrian fatalities among older people continues at a high rate indicates that these schemes as a whole are not very effective. Probably there is no one best method of teaching safety to older people. All the above means plus other new ones are necessary.

As for the young, obviously the best place to teach pedestrian safety to them is in the schools, where lessons in being a good pedestrian are

rapidly being introduced. As a result children are becoming more and more safety-minded. Eventually when our present group of children grow up they will undoubtedly be more conscious of the dangers of walking on the highway than their elders of today, who have never adjusted themselves to the idea that the road belongs to motorists.

Responsibility for small children too young to profit by safety instruction must be assumed by their parents, who must be made to realize the need for keeping them from playing in the road. If necessary they should be confined to a yard or fenced-in space where they are sure to be out of harm's way. In crowded sections cities should see to it that parks or open spaces for recreation are provided and instructions given to the police to prevent children from playing in the streets. It would in all probability markedly decrease child pedestrian accidents if playing in the road were made a violation in both towns and cities, and if the police were given authority to issue warnings or even impose fines on parents whose children were found so doing.

THE PEDESTRIAN PROBLEM IN BRIEF

Although some gains are apparent in decreasing pedestrian accidents, the man on foot is still being killed far too frequently.

Marked progress in the reduction of child pedestrian fatalities has been made, although injuries to child pedestrians are still frequent. Middle-aged or elderly persons constitute the bulk of pedestrians fatally injured. Fewer women than men are killed.

States which are highly urbanized and densely populated have a higher proportion of pedestrian deaths than sparsely populated states. In the latter states other types of motor vehicle fatalities are more common.

The majority of pedestrian fatalities occur in the fall and early winter, and at night rather than during the day. Pedestrians who are killed are nearly always unfamiliar with the problems of motor vehicle operation. They are often intoxicated and frequently found to be responsible for the accident.

The solution of the problem of pedestrian accidents will be found in unremitting effort of many kinds. Legislation must be passed which will define more adequately the rights of all users of the road. Engineering improvements aimed directly at protecting the pedestrian must be extended. Enforcement of suitable traffic regulations must be maintained. And education—undoubtedly the most effective remedy—must find new channels for reaching those groups which are known to be most frequently involved in pedestrian accidents.

CHAPTER XI

MAKING THE VEHICLE SAFER

Previous chapters have been concerned with problems relating to the driver and pedestrian. Chapters XI * and XII deal with the problems of improving the motor vehicle and the highway so that motorists can use them more safely.

THE IMPORTANCE OF SAFE VEHICLES

Analysis of accident summaries shows that about 5 per cent of all accidents are caused by defects in the vehicle. Undoubtedly faulty equipment is a contributing cause of a still larger proportion of accidents; for example, dim headlights may prevent a driver from seeing an obstruction at night, poorly adjusted brakes may lead to skidding on slippery surfaces or to running off the road, a dirty windshield may hide a pedestrian from view. These and many other defects may help cause accidents even though the primary reason be failure on the part of the operator to have his car under sufficient control to meet an emergency successfully. It is essential, therefore, that continued efforts be directed at making the vehicle safer to drive.

IMPROVING CAR FEATURES FOR SAFETY

The car of today is vastly superior to the car of yesterday. Important safety improvements made during the last two decades include more efficient headlighting, four-wheel brakes, shatterproof glass, sturdier tires, easier steering, and stronger bodies.

But although the automobile has undergone tremendous improvement it is still far from perfect from a safety standpoint. [19, 97, 119, 143, 223, 267, 269] For this the public must be held jointly responsible with the automobile manufacturers.

* Criticism of this chapter by A. J. Schamehorn and E. W. Wilson of General Motors Corporation, J. W. Lord of the Atlantic Refining Company, and T. L. Preble of the Tidewater Oil Company is hereby gratefully acknowledged.

The automobile industry lives by virtue of a demand for its product, and even though its engineers may be able to construct safer cars, the producer has to offer the public what it will buy. Of course, an automobile is made to be run, but first of all, it must be sold.

An American's social status is judged by the appearance of his car, or so many Americans seem to think. Thus we have the sleek, shining, expensive-looking modern automobile, upon whose "eye-appeal" large expenditures are made, even though the same money spent for improvements in other parts of the car would increase its dependability and safety. Competition for sales forces manufacturers to divert a large amount of car value into salesworthy gadgets and style features. From this overemphasis on styling safety has suffered.

The vehicle could be made safer to drive in a number of different ways. One way would be to improve visibility. Other methods would be to give it more effective headlights; to provide it with some means of counteracting glare, both at night and in the daytime; to supply better brakes and steering, more driver comfort, easier controls, crash and carbon monoxide protection; in some cases, perhaps, to install speed governors; to improve the hill-climbing ability of trucks; and to discourage the use of old and low-quality tires.

Visibility

Since driving is carried out largely through the sense of sight, the driver needs as much visibility as possible.

Present car design represents a compromise between two alternatives: (1) raising the driver's seat and consequently the top of the car, which results in good visibility but a high center of gravity, or (2) lowering the driver's seat and the top of the car, which gives restricted visibility but a lower center of gravity, thus reducing the risk of the car overturning on curves and turns. Our modern cars, in spite of a recent tendency to raise the operator's seat slightly and to lower the hood, still incline toward the second pattern, which not only gives the driver a limited field of vision, but also makes him suffer more at night from the glare of approaching headlights. Moreover, the trend toward streamlining the body by increasing the slope of the windshield has the minor disadvantage of collecting more dirt and making defrosting more difficult. [97, *299*] But it should also be mentioned that a major advantage of the sloping windshield at night lies in its elimination of distracting reflections from the headlights of following vehicles.

One of the prime advantages of the rear-engine car, which has appeared in Europe and is being experimented with by American manufacturers,

is the fact that it seats the driver at the front where he can see better. There can be little argument about the rear-engine car offering greater visibility.

Up to the present time, however, the rear-engine car has had a serious disadvantage which has more than offset its improved visibility, namely, its poor handling characteristics. Our front-engine vehicle, the result of long years of experience, has a proper load distribution which gives it good road-ability; it hugs the ground on curves and handles easily and safely. Present-day rear-engine cars with entirely different weight distributions have proved to have much less dependable manipulative characteristics. Until this problem is solved American manufacturers are hesitant to put rear-engine cars on the market.

Furthermore, manufacturers question whether the American public will take to rear-engine cars. They are not sure that the driver in a rear-engine car would feel as secure in an unprotected position over the front wheel as he does behind the engine in his present automobile. Manufacturers also wonder whether rear-engine cars, if they were to come into common use, would significantly reduce accidents. Many present-day buses have their engines in the rear. This permits the driver to be located over the front wheels, thereby affording him maximum visibility. Rear-engine buses are on the increase and are preferred by drivers to the front-engine variety, but bus companies do not report any noticeably lower accident rate for rear-engine as compared to front-engine buses.

The trend in automobile design has been toward improved visibility, but there would seem to be a need for still further increasing the driver's field of vision by reducing the dimensions of the front corner posts and other supporting elements of the body between the windows to the minimum necessary for structural strength. The diagram below shows the large blind areas which now exist in a conventional coupe. The blind areas actually are greater in extent than the areas visible to the driver. By reducing these blind areas the number of accidents resulting from restricted vision would certainly be reduced.

One author suggests that improvement in visibility would be attained if the passenger seat alongside the driver were moved back six to eight inches to enable the operator to see past his companion. [143, *36*]

Although an unrestricted field of vision is to be desired, this factor is sometimes overstressed. [128] Only when starting from a standstill or when moving at very slow speeds is the restriction of vision caused by the hood and corner posts of major hazard. When the car is moving along the highway at ordinary driving speeds the alert motorist will see long before he reaches it any fixed hazard, which may later be cut off by the corner posts or hood of the car.

It should be pointed out, however, that although a moving motorist has no considerable blind spot so far as stationary objects are concerned, he may not see a pedestrian or vehicle approaching from the side at just the wrong speed until it is too late to avoid a collision. Similarly, the blind spots created by the rear body wall may hide a following vehicle from view and contribute to an accident.

It would be ideal from the standpoint of visibility to have no opaque body sides at all to obstruct the view of the driver. On the other hand,

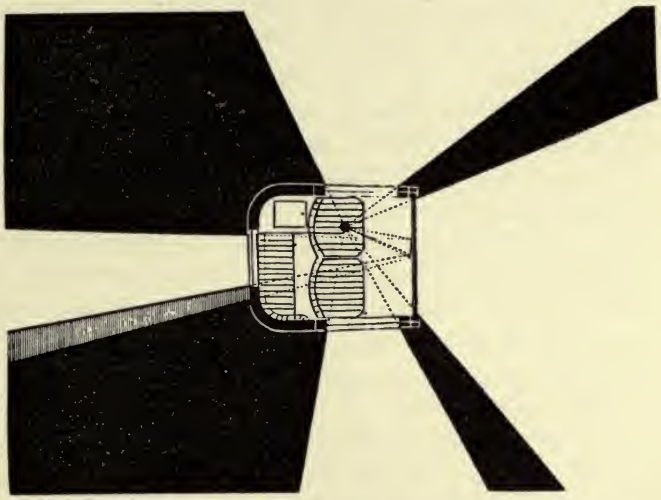


Fig. 46. Diagram of automobile showing its blind areas.
Source: V. W. Killick, *Can We Build Automobiles to Keep Drivers Out of Trouble*, p. 35. Reeves Publishing Company, San Francisco, Calif.

"crash protection" demands that the corner posts and body sides be sufficiently sturdy to support the top in case the car overturns. A suggested solution to the problem is to use a transparent material of suitable structural strength. But such material is not yet available, and if it were, it is unlikely that plastic corner posts of the required thickness could be seen through readily.

Headlights

One safety feature of the automobile which has made little progress until recently has been the headlighting. The slow advance in perfecting headlights can be attributed to two factors: (1) lack of cooperation between manufacturers and (2) divergent state laws regulating the candle power and beam adjustment of headlights, and other pertinent matters.

About three years ago the manufacturers of automobiles solved the first difficulty by finally agreeing to work cooperatively as an industry to improve the headlighting situation. The American Association of Motor Vehicle Administrators took steps to remove the second stumbling block by urging the various states to adopt uniform laws and regulations permitting an increase in candle power and other general improvements in lighting.

The immediate result of this cooperation of the automotive industry and the state motor vehicle departments has been the appearance of the new "sealed-beam" head lamps, which have a higher candle power than older lamps (50 c.p. for the "high-beam" as compared with about 32 c.p. for the old-style lights); and whose filaments, reflector, and lens make one sealed, airtight unit. These lamps do away with the problem of adjusting filaments to the reflector and the lens, since this is done once and for all at the factory. They also ensure a bright reflector since no dirt or dust can reach it. They illuminate the road better, are simple to adjust for direction and last longer than the old type head lamps. Manufacturers report that many owners of older cars are now installing the sealed-beam lights, which may be purchased separately. But, although these new lamps represent a distinct advance in headlighting, they do not give a completely satisfactory solution to the headlighting problem.

The increase in illumination which results from the use of the sealed-beam unit is of considerable benefit to the driver of the car on which it is installed, but putting powerful head lamps in the hands of the ordinary driver is like putting a sharp knife in the hands of a child who does not care what he cuts with it. These high-candle-power lights are being flagrantly misused in a great many cases by drivers who do not take the trouble to switch to their passing beams when approaching another car, or when traveling through cities or towns. This discourtesy is particularly dangerous when the approaching car has dim, inadequate headlights.

For some unknown reason many truck manufacturers still continue to install the old-fashioned head lamps in their products. This is unfortunate since truck drivers, even though operating at lower speeds, are just as much in need of efficient lighting at night as are passenger car drivers.

Motorists are frequently unable to get their headlights adjusted properly by the private agencies which perform this service. The trouble lies with lack of proper testing equipment, flat floors to use it on, and lack of men trained to test and adjust the lights. Much remains to be done to train garage and service station employees in the correct adjustment of head lamps.

Glare Protection

The problem of headlight glare is still with us despite other advances in lighting.

Polarized Headlights. When a new polarizing material was discovered a few years ago it was hailed as a solution to this pressing problem. Polarizing material works on the principle of letting through only light rays vibrating in one plane. Thus when two cars (whose polarizing headlights are furnished with material which permits passage of light rays in, say, only a vertical plane, and whose windshields are equipped with polarizing material transmitting only light rays in a horizontal plane) approach one another, both drivers looking through their windshields can barely see the opposing headlights and are protected from their blinding effects.

This plan of using a sheet of polarizing material in the lamps and windshields of automobiles is being given serious consideration by automobile manufacturers, but it is not yet thought to be feasible for general use for a number of reasons: [142]

1. Assuming that polarizing screens were readily available, there would be no incentive for the individual owner to equip his car with them unless he knew that the cars he would meet on the road would also be so equipped. This would require the passage of laws in every state enforcing the use of polarizing material on all vehicles both old and new.
2. Since the polarizing screens absorb about 60 per cent of the available light of head lamps, it would be necessary to use headlights giving approximately two and a half times the light output of present head lamps to secure the same degree of illumination on the highway. Heavier generators, larger electrical cables, improved switch contacts or relays, and perhaps heavier batteries would be required. The cost of refitting old vehicles would be particularly high and certainly not popular with their drivers.
3. The polarizing material itself is still relatively expensive.
4. The use of polarizing material, by cutting down on the oncoming car's light beam and its illumination of the roadway in front, makes a motorist's judgment of the distance away and of the speed of approaching vehicles more difficult.

Defense Against Sun Glare. Sun glare may be as blinding as headlight glare, if the motorist must drive with a bright sun shining in his eyes, as is often the case in late afternoon. Little has been done to do away with this discomfort and danger aside from the installation of sun shields, which are not altogether effective. One suggestion is that every driver should carry sun glasses in the package compartment of his car.

These not only help him to see better when facing the sun, but also reduce the strain on his eyes when driving in bright sunlight or in the reflected light from snow.

Braking

Most accidents result from collisions, a great many of which could be avoided if all cars were equipped with brakes which functioned properly. Both the hand as well as the foot brakes of many vehicles are inefficient and untrustworthy. [228, *3*]

For maximum reliability and safety in braking the following are essential requirements: (1) good brake linings, (2) proper adjustment of brakes on all four wheels, and (3) brakes of adequate size and design to meet the actual needs of the vehicle as it will be used.

Contrary to general opinion brake linings cannot be expected to last for any definite number of miles or years, for individuals vary considerably in the frequency and severity of their brake applications. Brake linings may wear out after a short time through hard usage if drivers, as many of them do, use their brakes more often and more abruptly than is necessary. Motorists should therefore be encouraged to have a good garage mechanic check their brakes two or three times a year to make sure they are still serviceable. And both passenger car owners as well as truck owners should, when the time comes for renewing brake linings on their vehicles, insist on procuring first quality linings such as those recommended by the manufacturer.

Unequal adjustment of the brakes on the four wheels can usually be detected by applying the brakes forcefully while driving on a flat pavement. If the car swerves to the right or left, or one or two wheels make skid marks on the road, adjustments are in order. On trucks with their heavier loads it is even more important than on passenger cars that all brakes act equally. There is still a large part of the trucking industry that has insufficient appreciation of the need of a continual check on the efficiency of its trucks' brakes.

On account of the common habit of carriers of overloading their trucks, truck brakes are frequently inadequate in stopping ability. Two measures have been advanced to solve this problem. One is for the states and manufacturers to agree on maximum gross loads for specified vehicles, and have these limits made enforceable by the traffic police. The other measure is for manufacturers to equip their new trucks with better designed and more powerful brakes that will remain in balance longer.

Realizing our present imperfect knowledge about the performance characteristics of brakes in use on our highways today, the U. S. Public Roads Administration has launched an investigation on motor vehicle brakes

in cooperation with several interested federal agencies. Advising and assisting them is a committee formed of representatives of automobile and parts manufacturers, insurance companies, bus operators, and various other organizations, including the American Association of Motor Vehicle Administrators and the Society of Automotive Engineers.

The general purposes of this research program are as follows:

1. To determine what levels of brake performance can reasonably be met by current vehicles in service.
2. To determine the essentials of reasonable brake regulations.
3. To establish a better understanding of certain features of the braking phenomenon.
4. To determine practical means of enforcing brake regulations.

This research when completed will furnish a mass of valuable information on the braking performance of both private and commercial vehicles which will help in the long run to reduce accidents attributable in whole or in part to faulty brakes.

Steering

Ability to avoid a dangerous situation frequently depends on the quickness and ease with which a car can be steered. But speed and ease of steering do not go together. A car slow to turn usually steers easily, whereas a car that turns fast, i.e., that requires little turning of the steering wheel, generally steers hard. The tendency in recent design has been toward easier and, therefore, less rapid steering control.

From a safety standpoint, slower steering, which seems to be sufficient for all needs, is probably an advantage, for at high speeds the ability to steer rapidly might be dangerous and result in rolling over from too abrupt turns.

Driver Comfort

In order to function to the best of his ability, a driver must be in a comfortable position at the controls of his car. Fortunately this problem is receiving the attention of the Committee on Riding Comfort of the Society of Automotive Engineers. A valuable recent study on the effect of seat design on driving comfort is by Professor W. E. Lay of the University of Michigan, a member of this committee. [156]

The most serious criticism that can be leveled at modern vehicles from the standpoint of driver comfort is that there is often insufficient front seat adjustment to allow for drivers who vary considerably from the norm in stature. Since women are on the average three or four inches

shorter than men, they are especially handicapped. Many women have difficulty in reaching the foot pedals and hand controls. Because they have to stretch so far to reach the pedals their feet are likely to slip from the brake or clutch with results which may be serious. In some car models visibility for people of small stature is so poor that even a short drive is excessively fatiguing to them.

The figure below shows the rather substantial variation in the front seat leg room available on 1940-model cars. It will be seen that there

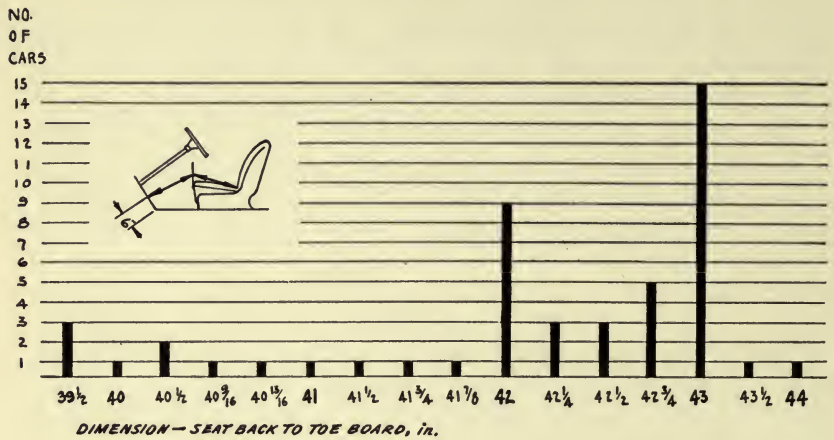


FIG. 47. Variation in front seat leg room on 1940-model passenger cars.

Source: C. R. Paton, E. C. Pickard, and V. H. Hoehn, "Seat Cushions and the Ride Problem," Fig. 19, *Trans. Society of Automotive Engineers*, 35, 279 (1940). Also courtesy *Motor*, October, 1939.

is little agreement as to what constitutes satisfactory leg room, the distance varying between 39½ and 44 inches.

On late-model cars manufacturers have attempted to increase driver comfort by furnishing seats that slide forward and backward. These help considerably to bring short persons nearer the foot controls, but they have not solved the comfort problem completely, for there is as yet no satisfactory provision for moving the driver's seat up and down. The short person still has to resort to pillows to see over the steering wheel and hood or to ease the discomfort from a cushion not tailored to fit the contour of his back.

High side windows are a particular handicap to a short person, making it almost impossible for him to put out his hand to signal. [228, *2*]

The tall person is hampered in a different way. When in the driver's seat he often has to stoop to see ahead down the road. When he is near a traffic light he has to lean out of the window to get a glimpse of it.

The steering wheel gets in his way when he shifts his foot from accelerator to brake.

A seat which may be adjusted really to fit the individual driver is sorely needed, both that he may not suffer from restricted vision or have difficulty in handling the controls. It has been suggested that to prevent the driver from sliding sideways on curves he be given a separate bucket-type seat whose rounded back would support him. This type of seat is widely used for drivers on buses. Another solution lies in the use of a non-slippery seat fabric (such as mohair) which anchors the driver more firmly in one place.

Among the most uncomfortable vehicles to operate are trucks most of which still have only the old-fashioned, straight, hard seats. Trucks as well as passenger cars should have properly designed seats and comfortable cushions so as to reduce driver fatigue to a minimum. [160, *3*]

Vehicle Controls

An important reason why radical changes in the control features of the automobile cannot be made suddenly is the difficulty of modifying the driving habits of millions of people. Even a relatively small change such as that from a hand brake on the right side to one on the left requires a period of adjustment. Very little systematic psychological research has been done on the efficiency of present-day controls. The traditional vehicle controls, having impressed automobile designers as being satisfactory, have become standardized.

An advance in the field of vehicle controls is marked by the recently introduced fluid clutch and automatic gear shifting. Both the fluid clutch and the automatic gear shift either reduce the use of or eliminate the need for a clutch. Liberating the left foot from the necessity of operating the clutch leaves it free to be kept in readiness on the brake pedal when driving in heavy traffic or on slippery roads. By reducing the amount of physical exertion in driving, these new devices also make the driver better able to concentrate on the road ahead of him. They are a particular boon to persons crippled in their legs. If fluid clutches and automatic gear shifting were more common on modern buses and trucks, driver fatigue would be reduced and the operator afforded more freedom to attend to the road in front of him.

It is especially desirable to standardize the arrangement of controls on trucks and buses so as to avoid the confusion resulting when operators are called upon to drive several makes and styles of these vehicles. There should be a standard arrangement and position of pedals, accel-

erator, hand brake and steering wheel. Uniformity in gear level positions is equally to be desired. [160, 5]

Crash Protection *

No really serious systematic research has been done by manufacturers on the ways of designing the inside of cars to soften the effects of crashes for the passengers, although when the number of cars predestined to be in collisions is considered, such crash protection would seem to be a necessity.

Some steps which have been taken to protect car occupants include the installation of safety glass in windshields † and windows, the removal of inside projections, and the padding of sharp edges in the interior of the car. Inner door handles have been rounded and relocated in positions where they are least likely to catch in sleeves and cause the door to swing open while the car is in motion. Further improvement ought to be made in the construction of the steering wheel, which should be so made that it would bend under the impact of the driver's body instead of stabbing him.

Each year a great many people in the United States are severely injured or killed by being thrown against the top of the car from the rear seat. [119] Padding the interior of the car top has been recommended to reduce this hazard.

A study made in Connecticut shows that two-thirds of the individuals succumbing in automobile crashes died of fractured skulls. [54] The most effective way to prevent drivers and passengers from getting their skulls fractured would be to provide safety belts to hold them firmly in their seats. Aviation has long made use of safety belts and helmets as precautions against crashes, as have professional dare-devil and racing drivers. The high proportion of deaths from fractured skulls would undoubtedly be reduced if occupants of cars, especially children, were strapped in while cars were being driven at high speeds. ‡

* A problem related to crash protection is protection of the car and driver from gasoline fires. Thus several years ago in one make of car the gasoline tank was located in front of the instrument panel over the engine. If a collision occurred the tank would sometimes rupture, allowing the gasoline to run over the engine, starting a fire which incinerated the occupants before they could extricate themselves. The location of the gasoline tank at the rear in present-day passenger cars greatly reduces the hazard from gasoline fires.

† All cars now manufactured are provided with safety glass windshields, which, however, do not prevent anyone from going through them in the event of a serious collision.

‡ The remarkable editor of the *Chicago Tribune* apparently believes in using a safety belt while riding. We quote from an article by Jack Alexander in the *Satur-*

The frame of the car body itself needs to be built strong enough to sustain the impact, should the car turn over. For protection of this sort the pillars between the front and rear doors and the front corner posts must be made strong and rigid. As we have stated earlier in this chapter, efforts to increase visibility will always be limited by the necessity of building the car body firm enough to withstand crashes. The all-steel bodies and "turret tops" used in modern cars are a help here as they are more resistant to crushing than wooden ones. Needless to say, an open car is much less safe than an enclosed one since it affords little protection against being thrown out, through the sides or the top. Rumble seats are particularly dangerous.

Bumpers as now located afford little protection to the body of the car. They do not extend far enough out to protect the fenders, or high enough to protect the radiator or back of the car, and are easily bent. Truck bumpers should be at the same height as those on passenger cars, to make contact with car bumpers and prevent the destruction of passenger car radiator grills and head lamps, for which they are commonly responsible. Rear bumpers of the correct height are especially needed, for backing accidents often account for 10 to 20 per cent of all accidents in many truck fleets. [160, 7]

To protect pedestrians modern automobile designers are gradually doing away with piercing radiator ornaments, sharp door handles and other projecting elements. One enthusiastic inventor would even have us install "cow catchers" on our vehicles to scoop up unwary pedestrians. Research needs to be carried out on the effect of the interior design of the car on the injuries received by the occupants in accidents. Perhaps an entirely different conception of interior design is desirable.

Protection Against Carbon Monoxide

Carbon monoxide poisoning is a source of danger for motorists, not only in unventilated garages, but also in closed cars in the open. Leaks in the exhaust manifold under the floor may result in an accumulation of carbon monoxide in the car; or exhaust gases from the preceding car, especially in heavy traffic, may be sucked into the passenger compartment.

day Evening Post, July 19, 1941, p. 74: "At ten A.M. he starts for town in a sand-colored sport coupe which has been tailored to accommodate the long McCormick legs. The publisher sits alongside the chauffeur, reading the morning headlines or silently musing. Drawn tightly across his lap is a webbed safety belt. McCormick loves fast driving, and the belt is insurance against getting pitched through the windshield in the event of an accident. At one time he tried driving himself, but abandoned the effort as a matter of safety when he found that he concentrated too much on *Tribune* problems and too little on where he was going."

Station wagons are sometimes dangerous in this respect because exhaust gases from them are easily drawn into the vehicle itself.

It is generally known that carbon monoxide is a colorless and odorless gas which even in small quantities is a deadly poison. [248] It is less well understood that still smaller amounts impair the judgment and reaction time of the driver. Studies made some time ago of cars picked at random from state highways showed that from 2 to 5 per cent of the vehicles contained sufficient quantities of carbon monoxide in the passenger compartment to cause symptoms of headache, dizziness, nausea, drowsiness, lowered reaction time, or defective judgment, after an exposure of from one to two hours. [244, 280]

Closed cars should always be ventilated, preferably with two windows at least partly opened; and a periodical examination of the entire exhaust system should be made as a matter of routine. The floor of the vehicle should be sealed to prevent exhaust gases from seeping in. To aid ventilation in rainy weather a desirable feature on both passenger cars and trucks would be a so-called "rain separator" on the cowl ventilator, a device which allows the rain to run off, at the same time admitting fresh air. The cabs of trucks used for long-distance hauling should ideally be provided with motor-driven ventilators.

On station wagons the exhaust-pipe outlet should be so located that fumes merge with the slip stream of air rather than with currents that draw them into the rear compartment. Station wagons with streamlined bodies do not have this difficulty.

Although the carbon monoxide hazard is a real one and should be given proper recognition, there has been a tendency in some quarters to exaggerate its importance. The number of cases of road accidents from carbon monoxide poisoning is actually very small and its complete eradication would probably not affect at the most more than a small fraction of the total number of automobile accidents.

Speed Governors

One of the panaceas which has been offered for the solution of the vehicle-speed problem is the installation of speed governors on motor vehicles. These are devices attached to the carburetor, to limit the amount of gasoline it can furnish to cylinders, and they thereby make it impossible to drive beyond a specified number of miles per hour. Governors are anything but popular with the driving public for the simple reason that a speed governor restricts the freedom of the individual to drive as fast as he wants.

Speed governors have not been made legally compulsory anywhere in the United States, for there are several practical obstacles to their use. One is that modern driving demands a considerable degree of flexibility in the speed of the vehicle. There are occasions when a considerable increase in speed is necessary in order to get out of a dangerous situation. The advocates of speed governors reply to this criticism by pointing out that if drivers knew what the top speeds of their automobiles were, they would keep out of situations in which acceleration beyond this limit was called for.

Another objection to the national use of speed governors is that safe speeds vary considerably on different roads and in different localities. In congested districts lower speeds are necessary, but in sparsely settled districts and on express highways higher rates of travel are relatively safe. In the middle west and in the south where high speeds are very much more common, governors would be much more objectionable than in the congested northeastern section of the country.

Other objections to speed governors are their unit cost, and the fact that it is difficult to make a speed governor which cannot be tampered with. Until speed governors are marketed at prices within reach of the average motorist, and, more important, until they are made tamperproof, legislation requiring all drivers to use speed governors is not to be expected.

The most enthusiastic advocates of governors are certain truck owners. A number of truck fleets which have installed governors report that their accident rates have been reduced and their schedules maintained. Bus companies, however, have not taken to governors since they would tend to slow down prevailing schedules.

Hill-Climbing Ability of Trucks

Greater hill-climbing ability is an outstanding need of heavy freight vehicles if the hazard created by passenger cars trying to pass such slow-moving vehicles on hills is to be reduced. Improvement in climbing may be gained in either of two ways: by providing the trucks with higher motive power or by reducing the loads carried by them to limits fixed by the present capacity of their engines. In either case it will be necessary in order to prevent present abuses of overloading trucks to require truck manufacturers to define the load limits of their vehicles, and for states to enforce such load limits. [273]

Tires

By the use of tougher fabric and rubber with greater resistance to abrasion, manufacturers are furnishing us today with tires which are durable and, when new, proof against blowouts under ordinary driving conditions.

But in spite of the high quality of most of our standard tires it must be admitted that tires are still a factor in accidents. In Pennsylvania, for example, 1 per cent of reported accidents are attributed in part to blowouts. There are several reasons for this: (1) use of underpriced, poor-quality tires and tires with worn-out treads; (2) overloading of the vehicle; (3) underinflation of tires and incorrect adjustment of the brakes or steering mechanism; and (4) too fast driving.

Although the average car is supplied with tires of good quality when first delivered, there is a tendency on the part of owners, especially those in low-income groups, to use cheaper and cheaper tires as the cars age. Unfortunately many cut-price and retreaded tires are not strong enough to stand up under hard service. Such poor-quality tires, like those which are worn out, are particularly subject to blowouts.

When tires are overloaded they tend to heat up and, particularly in the summertime, may give way. Most passenger cars are supplied with tires amply large enough to carry capacity loads of passengers and luggage, but truck owners can overload their vehicles, thereby wearing out their tires prematurely and risking accidents from tire failure.

Tires which are unevenly worn are likely to suffer punctures or blowouts. Common causes of uneven wear in tires is faulty alignment of the front wheels, unequal brake adjustment, or underinflation. Whenever there is a sign of uneven wear on a tire, in addition to testing the air pressure, a check should be made of brake and front-end adjustment. Tires should be regularly inflated at filling stations at the same time a check is made of water, oil, and battery.

Present-day tires are not made for continuous speeds much greater than 80 miles per hour as tire failures at high speeds on hot days on the Pennsylvania Turnpike have recently demonstrated. Cars with badly worn and cheap tires should never be driven at more than moderate speeds.

Safety Gadgets

Along with all of the praiseworthy efforts at improving the safety factor in the motor vehicle should be mentioned some that are not so beneficial, and some that are impractical and useless. As D. M. Baldwin, Safety Engineer for the Virginia Division of Motor Vehicles, says:

Gadgets guaranteed by their sponsors to prevent all traffic accidents, or at least 50 per cent of the total, are the bane of existence of most State safety men. In a State motor vehicle department these gadgets flow in an endless stream across someone's desk. Undoubtedly motor car manufacturers see a large number of these trick devices, few of which are practical for use.

The field includes all the safety features of a motor vehicle, but there has been a concentration on headlamps, probably because headlamps seem to be an unsolved problem. Directional signal devices, moving stop lights, recording speedometers, identifying parts that fall off at the scene of an accident to convict a hit-and-run driver, whistles that blow at speeds over the legal limit, reenforced front axles, automatically defrosting windshields—the list could go on nearly indefinitely. . . .

It is interesting to note how well the public has accepted some of the gadgets and how they resent being told that their pets are really nothing but sales tricks. To go back to lighting, the familiar yellow or amber fog lamp with its "fog-penetrating" yellow light is a prime example. The U. S. Bureau of Standards says that yellow light does not penetrate fog. The advantage of the fog lamp lies in its beam pattern and position on the vehicle. The public has been completely taken in, however, and few crystal lenses are sold for fog lamp use although the latter are more efficient. [25, *9*]

THE EFFECT OF DESIGN AND COMPULSORY INSPECTION ON THE SAFE OPERATING CONDITION OF VEHICLES

Badly needed is the establishment of standards by which to judge the safety factors involved both in the design and in the maintenance of vehicles. Surveys should be made of accidents with a view to determining the part played by faulty design of the vehicle, as for example:

A truck manned by a competent driver was proceeding at a moderate speed on a street in a New England city. It struck a chuck hole in the pavement which was about 11 inches deep. This obstruction was not known to be a chuck hole by the driver because it was level with water from a recent rain. The vehicle turned over and incurred damage to the extent of $900.00. Undoubtedly in tabulating this accident the city authorities blamed the highway. However, examination proved that because of a lack of proper directional stability due to far too little weight on the front axle the situation was aggravated; in fact it is probable that the truck would not have rolled over but for these defects, *not* in equipment, in workmanship, in metallurgy, etc., but rather in very inefficient "tailoring" of the vehicle. . . . Undoubtedly improper load distribution, inadequate braking area in proportion to gross weight, an overloading of tires and axles have contributed directly or indirectly to many accidents which have occurred without benefit of tabulation. [228, *4*]

Only by careful research by some organization like the Society of Automotive Engineers to establish a set of practical standards by which to judge the safety factors involving both design and maintenance will efforts at improving the safety of vehicles, especially trucks, achieve a maximum degree of uniformity and usefulness.

Vehicle Inspection

Many motorists believe that a motor vehicle can stand up under steady driving for many thousands of miles without needing an inspection by a trained mechanic to look for worn or loosened parts. This view is a very fallacious one. Every car requires a careful inspection every six months at least. Moreover, this semi-annual inspection is just as important for a new vehicle as for an old model, since new vehicles are driven more miles per year and at higher rates of speed.

Eighteen states and fifteen cities now have some form of compulsory vehicle inspection.* [10, 235] One of the most thorough inspection systems is that of New Jersey under the direction of James J. Shanley, where twenty-five separate items are checked each time a vehicle is inspected. [255] These include first of all the possession of proper license and registration certificates. In addition the vehicle must be able to meet the standards specified for the following items:

1. Steering alignment.
2. Steering operation.
3. Vehicle dimensions (referring chiefly to the height, length, and width of large commercial vehicles).
4. Identification plates (whether clean and in good order).
5. Examination of all glass.
6. Obstruction to vision.
7. Horn.
8. Windshield cleaners.
9. Rear-view mirror.
10. Exhaust system.
11. Headlights (driving beam).
12. Auxiliary driving lights (depressed beam).
13. Light output (in terms of beam candle power).
14. Parking and other lights.
15. Rear and stop lights.
16. Bulbs.
17. Wiring and switching.

* The American Association of Motor Vehicle Administrators with the aid of the National Conservation Bureau has recently worked out standards for inspecting motor vehicles which await adoption by the individual states. [10]

18. Reflect reflectors (red reflectors on rear).
19. Direction signals (on trucks).
20. Service brake.
21. Parking brake.
22. Brake equalization.
23. Pedal and lever reserve (to check worn brakes).
24. Miscellaneous.

To secure a sticker and remain on the New Jersey highways cars must pass each of these tests biannually. Cars which do not come for examination or cannot pass it lose their registration plates. Each year New Jersey removes from the road 35,000 vehicles because of their inability to meet the requirements for mechanical safety equipment.

Table 74 gives the percentages of the most common defects found in different items of equipment in New Jersey.* Note that faulty lighting

TABLE 74

REASONS FOR VEHICLE INSPECTION REJECTIONS
(New Jersey, February 1, 1939 – July 31, 1939)

	Per Cent of All Defects [1]
Lighting system	47.5
Braking system	31.1
Steering mechanism	9.7
Display of license tags	2.0
Registration and license cards	1.5
Exhaust system	1.3
Windows and windshields	1.2
Windshield wiper	1.1
Horn	0.6
Obstruction to vision	0.3
Rear-view mirror	0.2
Directional signals	0.1
Miscellaneous	3.3

[1] These percentages represent the number of times a particular vehicle defect was found. Thus, when one car was rejected for having two or more defects, each of these items was included in the figures.

Source: *Report of Vehicles Inspected,* p. 2 (mimeo). State of New Jersey, Department of Motor Vehicles, 1939. Based on inspection of 976,918 cars made during the period.

accounts for nearly half of the defects causing rejections. Lights are more poorly maintained and get out of order more quickly than any other safety feature. In order of importance next to lighting comes the brak-

* "Rejections" as used in the following tables does not mean that the vehicle so rejected must be removed from the road permanently. Many rejected vehicles needed only minor adjustments before they were in shape to pass the inspection successfully.

ing equipment, with nearly one-third of all defects. The third item in importance is the steering mechanism. It accounts for about one-tenth of the rejections. Altogether, lighting, braking, and steering defects account for 88 per cent of all rejections.

Drivers can be trained to keep their vehicles in a better state of repair, but this cannot be done quickly. Figures from New Jersey show only a slow increase in the proportion of vehicles passing the initial examination in the three inspection periods. The fact that the proportion of

TABLE 75

PERCENTAGE OF CARS APPROVED ON INITIAL INSPECTION
(New Jersey, 1938–1939)

	First Period	Second Period	Third Period	Fourth Period
Cars approved on initial examination	35.2	42.1	46.0	44.9

Source: *Report of Vehicles Inspected,* State of New Jersey, Department of Motor Vehicles, 1938 and 1939.

approvals dropped in the fourth inspection period indicates that little further increase in the percentage of first-run approvals can be expected under the present conditions.

The high proportion of cars which are rejected is proof of the high standard of the New Jersey examination, and also indicates that the majority of drivers do not keep their cars in prime condition even after they have become accustomed to compulsory semi-annual inspection.

LIMITATIONS TO FOOLPROOFING CARS

Great strides have been made in improving the safety features of motor vehicles and undoubtedly much should still be done. A note of caution must be struck at this time, however, regarding the part which we can expect such advances to play in accident reduction. A few extremists from time to time paint a glowing picture of "foolproof" automobiles, but unfortunately it is extremely unlikely that there will ever be such things. [228, *4*]

Instead of being more foolproof, modern automobiles are potentially many times more dangerous than vehicles of two decades ago, for they are being built with more and more powerful engines so that they can be driven at higher and higher speeds. Although the improvements we have discussed—such as more powerful brakes, better visibility, and higher candle-power lights—have helped the driver, they have not by any means compensated for the increased speeds at which the newer

models can be and are driven. Mechanical improvements of the vehicle, no matter how revolutionary, will never make motor vehicles accident-proof. Our chief hope is to offset the human frailties which are the chief cause of accidents by better training and more rigorous control of drivers.

The history of the development of safe rail and air transportation has shown that training and control of the human element are necessary along with technical improvements in machines. Our railroads and airplanes could not have built up their splendid safety records without setting rigid qualifications for the employment of engineers and pilots, prescribing courses of training for these men and supervising them closely. To this careful regulation and supervision of their operating personnel, more than to any other one factor, do these utilities owe their excellent accident records. Locomotives and airplanes are certainly not automatically safe. It is just as foolish to expect automobile manufacturers to build automobiles of that kind. Improvements are desirable, but machines can never be made safe in the hands of careless operators.

RESEARCH NEEDED ON THE OPERATIONAL SAFETY OF THE VEHICLE

Automobile manufacturers are disinclined to introduce improved safety features in the design of new automobiles unless drivers want such features and indicate their interest by buying automobiles which have incorporated them. Public leaders and safety organizations must help to educate drivers to realize the importance of safe mechanical features in an automobile and to remove the overemphasis placed on its appearance. Much of the responsibility for lack of progress in automobile safety equipment can be traced to the apathy and lack of interest in safety shown by the driving public. If it were aroused to demand safety features it would spur the manufacturers on to provide them.

Automobile manufacturers have set up and supported splendid research laboratories to improve the mechanical design and construction of the motor vehicle with a view to making it function better as a mechanism. There is still considerable opportunity, however, for more and better research on ways and means to adapt the automobile, not only to the physique of the motorist but also to his driving habits and reactions as shown in the type of accidents he incurs. Automotive research laboratories and proving grounds are strong on engineering but weak on the psychology of operating safety. To be sure they make laboratory studies aimed at discovering structurally weak parts in the vehicle which may fail as a result of sudden strain or continued usage, but they have made

little systematic effort to find out what influence changes in mechanical design have on the human factor in accidents. Cooperative research by automobile manufacturers, motor vehicle departments, and commercial vehicle fleets is badly needed to ferret out those features of private and commercial vehicles, which, if redesigned, would contribute most to the reduction of accidents.

In addition, if automobiles are to be safer, we must see to it that they are kept in good operating condition. Statistics from states and cities which have installed efficient systems of inspecting vehicles have shown that the average operator cannot be depended upon to keep his vehicle in proper condition by himself. The only way to ensure all cars being kept in reasonably safe condition is to require a semi-annual inspection of all equipment whose absence or faulty operation may contribute to accidents. And the only sure way to sell vehicle inspection to the country as a whole is to produce evidence that it actually reduces accidents in those states where it has been tried out.

Finally, we must try to educate drivers to keep their cars in good condition at all times, instead of merely having them gone over just before they are presented at the inspection lane.* A most important feature of a vehicle inspection system is its influence in impressing the driver with the importance of maintenance, and with the fact that he will be held responsible for vehicle defects if he has an accident. Much remains to be done to stress the educational significance of the state vehicle inspection program to achieve this end.

* The Office of Defense Transportation is publishing an excellent little handbook entitled *Keep America's Trucks Rolling* which summarizes the necessary things an owner must do to avoid breakdowns and to prolong the life of his truck. For passenger car owners one of the best pamphlets is *The Automobile User's Guide with Wartime Suggestions* by General Motors Corporation.

CHAPTER XII

THE ROADWAY AS A FACTOR IN ACCIDENTS

This chapter will be concerned with the various features of the roadway which contribute to accidents. It makes no pretense of covering the field of highway engineering or of traffic control, but deals mainly with those aspects of highway administration, research, and planning which have a bearing on the accident problem.

GROWTH OF HIGHWAY ADMINISTRATION IN THE UNITED STATES

Prior to the appearance of motor vehicles, road building and maintenance were left mainly to cities and towns. As a consequence costs were high, improved mileage was scattered, and there was nothing of the nature of a national highway system. Even as late as 1916 only 5 states, Massachusetts, Connecticut, New York, New Jersey, and Maryand, had improved trans-state highway systems. [122, *760*]

The federal government interested itself in the highways in a small way as far back as 1893 when it established the Office of Road Inquiry. In 1901, the name was changed to Office of Public Roads, in 1916 to Office of Public Roads and Bridge Engineering, in 1919 to Bureau of Public Roads, and in 1938 to the Public Roads Administration. It was not until 1916 when the federal government made its first appropriation for so-called "federal-aid" highways that the movement to establish state road departments with adequate staffs and facilities for highway research and testing really got under way. In fact the creation of such facilities was made a prerequisite to the granting of federal aid. Scientific road building and a unified national system of highways, therefore, made their beginning in 1916. [101, 7]

Since 1916 the Bureau of Public Roads has had a place of leadership in highway matters. The quality of its technical research is widely recognized by highway engineers here and abroad. It was not until 1935, however, after Congress authorized that up to 1.5 per cent of all federal road money, matched by equal appropriations from the states, be expended on highway surveys that any extensive effort to coordinate our

entire system of highways could be made. The so-called "Planning Surveys" represent one of our most comprehensive and most effective attempts ever made at cooperative federal-state planning.

THE WORK OF THE PLANNING SURVEYS

The primary objects of the Planning Surveys are to determine the present status of our highway system, to forecast future needs, and to figure out how the costs should be allocated.

The present Planning Surveys are now, for the first time, providing a complete and uniform inventory, in the form of maps and statistical tables, of the characteristics of rural roads. Altogether 3,100 maps, one for each county in the United States, are being drawn, on a scale of an inch to a mile. The capacity of highways of different widths, alignments, and traffic densities are being measured. Selective improvement depends, in the first analysis, upon an accurate inventory of what already exists.

From critical studies of the numbers of passenger cars, trucks, and buses now using these roads, forecasts are being made of future traffic. For example, the Public Roads Administration estimates that with normal conditions the car miles driven in the United States in 1960 will be about one and a half times those of 1939, although the increase in the number of motor vehicles will probably be no more than 20 per cent, or a total of some 38 million cars. To the Public Roads Administration it also seems likely that in the future motor vehicles will be driven farther. [110, 239] Proper planning for future highway construction requires accurate forecasting, based on studies of the growth of traffic in the past, and studies of future needs, not only of the United States as a whole but also of the individual states, counties, and cities. [96]

Included in the Planning Surveys are recommendations for the equitable allocation of funds for the construction and maintenance of the various types of roads in a state in terms of the maximum benefit to highway users as a whole. Thus in Michigan the state trunk lines, which comprise 10 per cent of the total rural * highway mileage, carry 63 per cent of the total traffic, whereas county and local rural roads, which comprise 90 per cent of the road mileage, carry only 37 per cent of the traffic. [141, *29*]. Obviously an allocation of funds to the different sections of the highway system must take such facts into consideration.

Finally, a few of the State Highway Planning Surveys are commencing to make direct contributions to highway safety in investigating the part played by the various elements of the highway in traffic accidents. This

* "Rural" here refers to all roads outside of cities.

phase of the Surveys, although of transcendent importance from our point of view, has been initiated in only a few of the states because of the exigencies of time and money. It is hoped that the Surveys can give more attention to the safety problem in the future, now that much of the initial work on road and traffic inventories has been completed.

THE INADEQUACY OF OUR PRESENT ROADS

It has been said with pardonable facetiousness that "the chief drawback of present-day roads is that they do not wear out fast enough," for the average life of a surfaced roadway is roughly three times that of an automobile. This ratio—desirable as it is from the standpoint of economy—is at the bottom of our road problem. Roads designed to fit the needs of vehicles as they were fifteen or twenty years ago can scarcely be expected to carry today's much speedier traffic with complete safety. This idea was expressed by Herbert S. Fairbank, Chief of the Division of Information of the Public Roads Administration, when he said:

> At this time it is not difficult to explain and excuse the findings of the planning surveys which indicate the presence on our principal roads of numerous curves too sharp, and sight distances too short for the safety of traffic moving at present maximum speeds. These inadequacies we may attribute with reason to conditions unavoidably associated with the "growing period" of both the vehicle and the roads; namely, the impossibility of predicting, and the undesirability of limiting the future design and speed of the vehicle at that stage of its development, and the impracticability of anticipating problematical increase of speed in the generally provisional design of the roads at their similar stage of development. [95, *19*]

PROJECTED IMPROVEMENTS IN OUR NATIONAL HIGHWAY SYSTEM

What can we reasonably predict as to the future construction and remodeling of our national highways? A comprehensive survey of the question has been made by the Public Roads Administration in response to a request by Congress for an investigation of the feasibility of constructing a system of transcontinental toll roads. The report of the survey, *Toll Roads and Free Roads,* contains an outline of a master plan for highway development in the United States. [239] Much of the discussion which follows is based on this report.

The greatest amount of effort in the future, as in the past, will of necessity be spent on the familiar two-lane road. In other words, the Planning Surveys are finding rather inconsiderable mileages of roads on

which traffic has reached such a volume as to suggest the need of more lanes than have been provided.

The main roads on which immediate work is to be begun form a part of a tentatively selected network of highways, to be known as the "Primary Highway System of the United States." This system, comprising 26,700 miles of roads, has been chosen to link practically all the most important centers of population. When it is fully developed it will comprise the most heavily traveled routes in the numbered federal highway

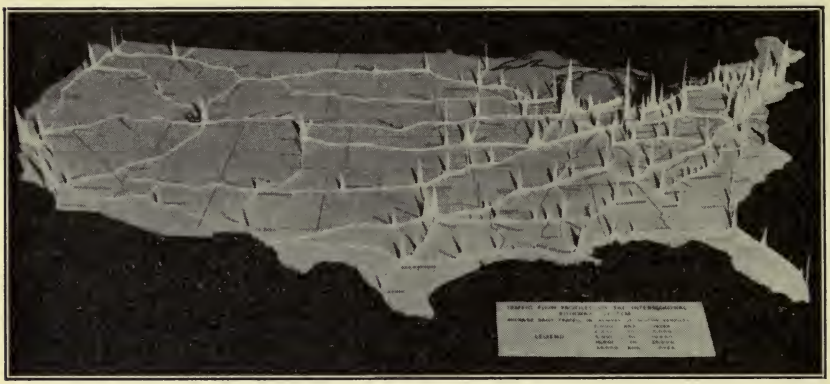


Fig. 48. Traffic flow profile of the U. S. Public Roads Administration tentative interregional highway system.

Source: H. E. Hilts, "Planning the Interregional Highway System," *Public Roads*, 22, 73 (1941).

system, including substantially every major line of interregional travel in the country. At large cities limited-access belt lines will be provided and all small communities will be bypassed—not entered.

Figure 48 graphically illustrates the tremendous variations in volumes of traffic on roads throughout the United States. The traffic density is very great on the relatively short sections of main highways near cities and dwindles to much smaller proportions on the longer stretches between cities. It is to the crowded trans-city connections of main highways and those sections near cities that first attention should be given.

Many miles of the future primary highway system will follow the alignment of existing highways and incorporate them in an improved form. Other stretches will involve the construction of new roads. Accident-deterrent improvements needed on existing roads which are to be included in the system are outlined in the survey as follows.

Specifically, the needed improvements include the reduction of excessive curvature; the flattening of heavy grades; an opening of longer sight dis-

tances; a general widening of pavement lanes; a construction of additional lanes and separation of opposing traffic where increased volume requires, and possibly also for the accommodation of slow vehicles on the heavier grades; the separation of grades at many railroad and highway intersections, and installation of protective cross traffic controls at others; [and] the abatement of dangerous roadside conditions of all sorts. . . . [239, *108*]

The existing roads which most nearly conform to the direct routes suggested in the plan now serve somewhat less than 10 per cent of the total vehicle mileage on all rural highways. The suggested routes, although they would represent as a system less than 1 per cent of the total rural highway mileage, would unquestionably accommodate at least 12.5 per cent of future rural vehicle mileage, with the additional advantage of reducing hazards and improving the flow of traffic.

The organization of our sprawling, loosely knit highways into an integrated system capable of serving the growing needs of automotive transportation in this country is a tremendous task. Fortunately the work of gathering the basic information for the wise expenditure of funds in a long-term highway development has already been well started by the Highway Planning Surveys. These surveys are so new, however, that we have not yet had time to realize their full value. As Herbert S. Fairbank of the Public Roads Administration says:

It is not to be expected that the full benefit of the vast accumulation of information that has been gathered by the surveys can be realized in a short time. The data gathered will remain useful only if they are currently revised to reflect changing conditions. The making of such revisions calls for the creation of a fact-finding division as a permanent part of every State highway department. This action has been recommended by the Public Roads Administration and already taken by the highway departments of a number of States. There is no doubt that substantially all of the States will make similar arrangements in due course.

For the support of the continuing planning activity of such permanent organizations a recent amendment of the Federal highway Act makes available not to exceed 1½ per cent of current and future Federal highway appropriations to be expended with or without matching State funds. [95, *28*]

But although the Public Roads Administration has taken the lead in gathering information and in attempting to unify and coordinate our highways into a national highway system, future progress in our roads, and incidentally in the reduction of our accidents, depends on each state adapting the suggestions of the federal agency to fit its own needs as well as those of the nation, and in giving to its highway department proper financial support. In the words of Commissioner MacDonald of the Public Roads Administration:

The key to a successful program lies in the state highway departments. The constructive work which has been done over the last quarter century by these departments is not matched by any other organizations within either the state or federal governments. Much of this solid accomplishment has been effected under adverse conditions of political manipulations, destructive changes in personnel, and adverse legislation. The situation has become particularly acute now that the professional organizers of municipal groups, chambers of commerce and other severely localized interests are demanding further division of the already seriously depleted income available for state highway departments. The only possibility of building a reasonable future program without a serious increase of taxes in some form is to concentrate the program and the jurisdiction of funds under these state highway departments. The proper program cannot emanate from Washington. It has been possible, through the consolidation of the data that have been secured cooperatively by the highway departments and the Public Roads Administration, to evolve the general pattern for a program such as has been indicated herein. But this has not been done without full consultation with the state highway departments. The approach to the goal of handling our highway problems within the present revenues and without greatly increased taxes lies in recognizing that the state highway departments must be accredited with an actually given general supervision over the year to year expenditures of the funds. Such a procedure does not deny either to municipal streets or to secondary roads a fair participation in the annual revenues. There can be in many states a reasonable meeting of the problems that give the only strength to the demands for further dividing of the funds, through the more equitable use of the funds by the state highway departments. [166, *27*]

POPULAR MISCONCEPTIONS ABOUT OUR FUTURE HIGHWAYS

Our highways are far from being as safe as we could make them. As Norman Bel Geddes and others have suggested, main highways consisting of a series of one-way troughs resembling those in the General Motors' "Futurama" exhibit at the New York World's Fair could be constructed. [112] But it is questionable first, whether such highways could be made "foolproof" against accidents, and secondly, whether we can afford to build very many miles of such superhighways.

Although the radical type of construction just referred to has not yet been attempted, some indication of the accident incidence which may be anticipated on such roads may be found in the experience of the roadway now in use which most closely resembles them in its type of construction.

The most modern superhighway in the United States is the Pennsylvania Turnpike, a divided four-lane toll highway, 160 miles long between Harrisburg and Pittsburgh. Far from being foolproof, during the first

six months of its use the fatality-per-vehicle-mile rate was double that for the United States as a whole. Unquestionably, superhighways facilitate the more rapid flow of traffic, but they are far from being accident-proof. Somehow drivers still continue to have accidents even on highways into which engineers have incorporated the latest and most expensive safety features. [240, *46*]

Limitations to the Construction of Superhighways

And however much we may desire Futurama highways, the facts are that only a very small proportion of the highway mileage in the country carries enough traffic to justify spending the huge sums (ranging from an average of $60,000 a mile where land is inexpensive and terrain is flat to $1,000,000 a mile in densely populated regions) [239, *67*] necessary for the construction of four-lane divided roadways of this type. For example, R. E. Toms, Chief of the Division of Design of the Public Roads Administration, estimated that:

> . . . insofar as we can visualize the future at this time, from 95 to 97 per cent of the State highway mileage * in this country may never progress in improvement beyond a 2-lane highway. [276, 7]

AVAILABILITY OF HIGHWAY FUNDS

Responsible highway administrators are usually the first to admit that the public welfare is best served by a well-balanced program of public expenditures for a variety of needs—among which highways are only one. Not that it is believed by the author and by others sincerely interested in the highway accident problem, that the money at present available for roadway construction is adequate, for even larger funds are desirable than those now available. Diversion of tax money specifically collected for highway use is particularly to be deprecated. However, it does not seem likely that under ordinary circumstances we can expect considerable increases in funds for highway building for the total cost for construction and maintenance of our entire United States road system already amounts to approximately 2½ billion dollars annually. [110] Highway construction in the future as in the past will be dependent on funds whose use must be justified in the light of general demands for public monies. Economic considerations will continue to govern the construction of roads and make it necessary to count the cost with considerable care.

* State highway mileage, which is maintained by state highway department funds, comprises about 10 per cent of the total rural highway mileage, and includes the great majority of important roads in each state.

LIMITED FUTURE TRAFFIC NEEDS

Highway improvement enthusiasts are inclined to offer exaggerated claims of the traffic to be carried by the highways of the future which they propose. However, officials of the Public Roads Administration who have made careful estimates of future traffic, predict on the basis of expected growth of population, gasoline consumption, registration, and other factors, that traffic growth in the future, although expected to increase considerably, will by no means parallel the remarkable increase of the 1920's and will not require facilities which differ markedly from the best types of current construction. [96]

The construction of modern four-lane highways with medial separation of opposing streams of traffic will probably be limited in the future to the trans-city connections of important highways and trunk lines joining centers of population which lie fairly near to one another. As Roy W. Crum, Director of the Highway Research Board of the National Research Council, expresses it:

> In congested regions multiple-lane divided roadways, grade separations, limited access, lighting, and all the other safety arrangements yet devised may be feasible but, on thousands of other miles of main roads, raising the cost of such improvements would tax the highway user out of business. As not even an approach to this condition is likely to be tolerated by public opinion, it remains that the only hope of improving the accident situation on hundreds of thousands of miles of roads and streets lies in persuading the drivers to operate carefully, and *in improving those features that constitute hazards to reasonably careful drivers.* [66, *384*] *

HOW MUCH DOES THE ROADWAY REALLY CONTRIBUTE TO TRAFFIC ACCIDENTS?

Although various estimates have been made from time to time of the percentage of accidents which results from imperfect roadways, or from a combination of causes which include roadway imperfections, unfortunately the present state of accident reporting does not warrant definitive statements as to the contribution of the roadway to accidents. The most that can be done is to examine the data which are available and risk a guess.

It is regarded as axiomatic in traffic safety circles that the great majority of accidents result from a combination of circumstances. The prob-

* The wording of this passage was altered slightly from the original at the suggestion of its author.

lem, therefore, is to resolve each accident into its primary and secondary causes and ascribe proper importance to each. Needless to say, such a procedure, although wholly desirable, is seldom possible. In consequence estimates of the contribution of any factor to the causation of accidents are bound to be of very limited accuracy.

The roadway may contribute directly to accidents, or an accident may result from a number of causes one of which may be traced to an inherent deficiency in the road. Accidents which are directly caused by "defects" in the roadway (using the word "defect" as defined in the footnote) * are believed to number from 3 to 10 per cent of all accidents. If we include all accidents in which a "fault" may have been one of the contributing causes (employing "fault" as defined in the footnote) it is conceivable that 15 to 40 per cent of accidents may be traceable directly or indirectly to the road.

It can readily be seen that the complete elimination of roadway defects in the narrow sense would have only a relatively minor effect on the accident total. And as we have previously indicated eradication of all faults in our roads can never be achieved on account of the high cost of the safest type of highway construction (four-lane divided with grade intersections). It is futile, therefore, to expect safer highways to reduce accidents drastically.

RELATING ROADWAY HAZARDS TO ACCIDENTS THROUGH ACCIDENT LOCATION

In order to reduce accidents caused by highway inadequacies it is necessary to determine precisely what features of present highways contribute most to accidents. Unfortunately, precision in determining the specific weaknesses of roadways is made extremely difficult by the lack of ade-

* One of the major reasons for inconsistencies in the estimates made by various individuals of the degree of responsibility of the road for accidents lies in differences in meanings attached to such terms as roadway defects or faults. To some individuals such terms imply only such obvious deficiencies as potholes, uneven or slippery surfaces, absence of guard rails where needed, washed-out or soft shoulders, which could be prevented by better maintenance or remedied by relatively inexpensive reconstruction. To other individuals, however, the terms have a more elastic meaning and include all those elements of the roadway which may fail to meet the highest standards of construction as practiced today, or even as visualized for the future. For example, to some visionaries any road short of a superhighway is at fault or defective, and any intersection which does not separate opposing traffic at different grades is to be blamed for all accidents which occur there. Such varied uses of the term roadway defect or fault is unfortunate. It might be much better if we could agree to use some such term as roadway "defect" for the narrow type of definition and, say, roadway "fault" for the broad inclusive type of definition.

quate information concerning the occurrence of accidents. In most states inaccurate location of those accidents which are reported and the lack of reporting of other accidents which occur make it impossible to determine that part played by elements of the roadway in the causation of accidents.

The obvious solution for this difficulty, a solution which it is hoped will be attempted in many states, has been suggested in a memorandum issued by the Public Roads Administration for engineers engaged in the State Highway Planning Surveys, entitled, "Outline of a Study of the Responsibility of the Highway in the Causation of Accidents." [94]

In this memorandum, methods are outlined for determining the accident rate per vehicle-mile for different units of roadway. By accurately locating each accident, average accident rates can be worked out for the various elements of the highway such as curves, intersections, tangents, grades, and for different road widths and types of surface.

Information on the accident rate per vehicle-mile, that is, the accident rate in relation to the traffic of different segments of highway, would serve several purposes:

1. It would aid in detecting abnormally hazardous highway features.
2. It would supply a foundation for determining the reduction of accidents to be expected following the elimination of certain physical road hazards.
3. It would provide a basis for ascertaining the safe capacity of the road in terms of vehicles per hour.
4. It would furnish information to aid in designing safer roads.

THE RELATIVE DANGER AND SUGGESTED TREATMENT OF DIFFERENT ROADWAY ELEMENTS

A few studies of the relative danger of isolated elements of the highway of the type mentioned above have already been made. Unfortunately, in most of these studies the data concerning the vehicle-miles traveled on the sections studied, together with other important variables, are not stated nor are roadways of different densities of traffic compared. Some of the elements of the highway whose relative danger has been studied include *curves, hills, intersections,* and *number of lanes.*

Curves

In South Carolina a study of the relative danger of curves and straight stretches showed that on sections of road with similar traffic conditions there were 1.57 accidents per mile on curves as compared to 0.98 accidents per mile on straight stretches. [261, *210*]

Another study, by the Ohio Department of Highways, indicated that curves having a degree of curvature greater than 4 degrees made up 6 per cent of the rural state highway mileage but contributed 15 per cent of the accident total. [*220, 9*]

The latter study also showed that over 50 per cent of the fatal accidents and 45 per cent of the non-fatal accidents occurred on straight stretches of road. But since 90 per cent or more of the highway distance was straight, or in highway engineering terminology, "tangent," in character, the accident rate per mile of straight highways was low as compared with that of other stretches of road. However, comparisons of vehicle mileages on straight roads as opposed to those on non-tangent stretches were not shown.

Research by the Public Roads Administration indicates that for safety at high speeds, curves of more than 3 degrees are not advisable. [239, *44*] A 3-degree curve permits the driver to see the road ahead for at least 690 feet, which is somewhat greater than the stopping distance for a car with good brakes going at about 70 miles an hour. Many of the curves on our old highways are much sharper than this. States are now following the 3-degree curve recommendation in straightening out their heavily traveled main highways, except where the terrain is such that the expenditure to attain this degree of curvature is excessively high. [123, *95*]

Curves are hazardous for two reasons. One of these is the danger of running off the road or turning over when taking a curve at high speed. The other reason is that a curve frequently restricts the motorist's sight distance and thereby increases the likelihood of collisions with other vehicles.

The danger from overturning or running off the road can be minimized by making the degree of curvature uniform, by banking the turn, and by providing a nonskid surface. Warning the motorist by roadside signs or pavement markings at suitable distances from a dangerous curve often helps to reduce the hazard by giving him a chance to slow down.

The danger from restricted sight distances can sometimes be eliminated by cutting down trees or other obstructions to vision. Where it is not feasible to remove the obstacles to vision the only way to provide a proper sight distance is to redesign the road with no more than a 3-degree curvature. Widening the pavement and painting a line down its middle also helps prevent collisions by keeping motorists on their proper side.

Hills

Hills, like curves, are hazardous. The Ohio study referred to above showed that hills with a grade of 7 per cent or more, constituting 2 per cent of the total rural state highway mileage, accounted for 8 per cent of all traffic mishaps occurring on such roads. [220, *9*]

According to experiments made by the Public Roads Administration, maximum grades should be not more than 3 per cent; in other words, there should not be a rise of more than 3 feet in 100 feet of road. [239, *44*] On such grades modern passenger cars in good condition are capable of maintaining their normal speeds, and trucks and buses properly powered and not overloaded can keep up a speed of at least 20 miles per hour. Heavy vehicles which are underpowered or overloaded, on the other hand, sometimes have to slow down to 5 or 10 miles an hour in getting over even such gentle slopes.

Slow-moving vehicles often provoke drivers of faster passenger vehicles to attempt to overtake and pass them on hills, with disastrous results. To reduce accidents of this type, as well as to speed up traffic, several steps may be taken:

1. Eliminate steep grades, or if this is not possible, widen the roadway to four lanes.
2. Require truck and bus manufacturers to put sufficiently powerful engines in their vehicles to handle the full load at a stated grade and enforce laws forbidding carriers to overload their vehicles.

The Public Roads Administration has considerable data available to assist states, manufacturers, and carriers to solve the latter problem. [273]

Intersections

In the Ohio study referred to, it was found that 25 per cent of all rural accidents occurred at intersections and private driveways, which constitute a very small fraction of the rural road mileage in that state. [220, *9*] A study in South Carolina in 1938 showed that the accidents per mile of road at intersections were more than twenty-five times as frequent as on straight stretches. [261, *210*]

There are several ways of dealing with intersections, depending upon the amount of traffic in conflict, the types of accidents which occur there, and the money available for remedial work. The most expensive and therefore the most infrequently used method is the grade separation, by which one intersection road is elevated above the other so that there is no conflict of traffic at right angles. The "cloverleaf" grade separation

is the ideal method of solving the intersection problem and preventing accidents, but it is very costly and can only be justified at a limited number of major intersections on main highways.

Another method of treatment is the traffic circle. This may be inexpensive or costly depending on the size. Small traffic circles are able to accommodate light traffic, but are of little help when the traffic is heavy. On heavily traveled city streets the intersection problem is usually helped by the use of policemen, traffic lights, and signs.

Number of Lanes

A number of studies have been made in recent years for the purpose of determining whether the number of lanes in a roadway has a significant bearing on the safety of travel. Results to date have been somewhat inconclusive. [59, *128*]

In an analysis of 5,500 rural accidents in Indiana, Hallett found that four-lane divided highways had the best accident rate per vehicle-mile. Two-lane roads ranked next in safety, followed closely by four-lane undivided highways, whereas three-lane roads had the poorest record. [115, *535*]

Evidence of a somewhat different nature has been reviewed by Barnett of the Public Roads Administration:

> There is some difference of opinion regarding the hazard to traffic on 3-lane highways. The highway departments of the States of California and New Jersey have reached tentative conclusions that a 3-lane highway has fewer accidents per million vehicle miles than a 2-lane highway. The State highway department of Massachusetts reached the same conclusion but found that as the volume increased to 2½ million vehicles per year the accident rate on the 3-lane highway rose sharply in relation to the accident rate on two-lane highways. New Jersey found the accident rate on three-lane highways about 2 per cent less than on four-lane highways, whereas Massachusetts found the accident rate on three-lane highways decidedly greater than that on four-lane undivided highways and the rates on both decidedly greater than that on four-lane divided highways. California also found the four-lane highway to be safer than the three-lane highway. [27, *12*]

There seems to be little doubt that the four-lane divided highway is safer than the four-lane undivided road. In New Jersey a study was made of the number of accidents that occurred two years prior to and two years following the conversion of a four-lane undivided highway to a divided highway and it disclosed that there was a remarkable reduction in accidents on the highway after it was divided. [282, *338*] Fatal accidents decreased 83.3 per cent, personal injury accidents declined 48.5

per cent, and property damage accidents diminished 17.6 per cent. It is believed that the physical separation of the opposing streams of traffic was largely responsible for the improvement.

A special study of the types of accident which occurred before and after the physical separation of the opposing traffic showed that the decrease occurred between intersections, and that the number of accidents at intersections remained approximately the same. Evidently dividing the highway does not have a maximum effect on reducing accidents unless the intersecting roads have a grade separation.

OTHER NEEDED IMPROVEMENTS IN HIGHWAYS

Among other recommended improvements to make highways safer are * (1) better signs, (2) more sidewalks, and (3) more extensive highway lighting.

Better Signs

The employment of signs to indicate maximum speed and the location of hills, curves, intersections, or other hazards, helps to prevent accidents provided the signs are of the right kind and are reacted to appropriately by the driving public. To be effective, signs must be uniform, properly located, and suited to their purpose.

A manual of uniform signs, signals and markings recommended by the American Association of State Highway Officials and the National Conference on Stréet and Highway Safety is available. [13] Although the majority of states now employ the recommended standard signs a few continue to use non-uniform signs. Unanimous adoption of uniform road signs by the states is a step much to be desired.

A set of regulations for the location of road signs is also included in the manual, but state highway engineers in the different states do not always conform to them, with the result that many spots are provided with unneeded signs and other places which should be marked are left unguarded. We need to know much more about where to put up warning signs. Certainly the prevailing driving speeds on roads should be considered in their placement; and when driving speeds change, the signs should be relocated in positions sufficiently in advance of the locations of the driving hazards.

* William Phelps Eno was the pioneer in the development of ideas for facilitating the flow of traffic and for the reduction of accidents on the highway. See in his most recent books the exposition of a number of valuable principles for the improvement of traffic. [92, 93]

The psychology of the driver must also be considered in the employment of signs. Since there are some states that do not require operators to prove their ability to read English before being granted a license, we should either make plans to require all drivers to show that they understand the present signs or else work out a system similar to that used in European countries, of symbols for use on signs in places of words. In addition we need to study further the typical driver's reactions to signs—his perception of different wordings, and the effect of the number of signs, their type, size, and location on his driving.

More Sidewalks

Pedestrian fatalities in rural areas average about 25 per cent of all rural highway fatalities and about 8 per cent of non-fatal injuries. Highway engineers should therefore give due consideration to any highway improvement that will cut down this important type of accident.

The most satisfactory thing that can be done to improve the safety of pedestrians on rural highways is to provide hard-surfaced sidewalks which will encourage persons on foot to stay off the road. Marked reduction of pedestrian accidents after the construction of sidewalks has been shown to occur. In Massachusetts, which has 850 miles of sidewalks flanking state highways, pedestrian injuries were reduced 25 per cent in sections where sidewalks were built.

Rural sidewalks are needed where there are many pedestrian accidents, or where the pedestrian traffic is heavy. Where the construction of sidewalks is not possible, roads should be provided with shoulders which pedestrians may use, and if there are many pedestrians, signs should be put up warning them to keep off the road.*

Highway Lighting

Numerous studies have indicated that the fatal accident rate per vehicle-mile driven is much higher at night than in the daytime. The night fatality rate on main highways in particular is increasing. Two effective ways of tackling the night accident problem are by driver control and improved automobile headlighting (see Chapter XI). Roadway lighting, however, has its place, particularly in danger zones such as intersections, abrupt curves, underpasses, and heavily traveled highways outside of large cities. Studies have shown a reduction in night fatalities after the installation of efficient highway lighting. [60, 278]

* Chapter X outlines ways in which the rural pedestrian can help protect himself.

DATA ON DRIVERS NEEDED IN PLANNING ROADS

Many important contributions have been made by highway engineers to the solution of the traffic accident problem, and in recent years a considerable amount of research has been carried out on the subject of the driver's behavior by psychologists. Very little thought has been given, however, to the possibility of correlating the activities of the two groups so that they will supplement one another. Certainly much worth-while research remains to be carried out in this marginal zone between the psychological and the engineering aspects of accident prevention.

The following types of information which involve both highway engineering and psychology would be of considerable help in designing safer highways and in promoting safer operation of traffic:

1. Information about the constitution of traffic at different times and places.
2. Reliable data on human driving reaction times and the ability to steer cars safely at different speeds.
3. Facts about the human causes of accidents at hazardous locations.
4. Data on driving habits and behavior.

The Constitution of Traffic

In highway design it is important to formulate general principles about the performance of traffic (considered as consisting of more or less identical elements) in terms of volume, speed, and under varying conditions such as on roads of different numbers of lanes and different types of surface, but it must not be forgotten that the constitution of traffic, which varies considerably at different times and places, also affects its behavior. Thus when traffic contains higher than average percentages of new vehicles and of motorists on long trips the speed will be higher (see Chapter III). As yet we know relatively little about the influence of variations in the proportions of different types of drivers and vehicles on accident rates. There are many indications, however, that an investigation of the relative accident rates of different types of drivers (such as urban and rural, old and young, commercial and private, colored and white, male and female) might yield useful information to help explain some of the variations in accident rates between similar stretches of highway when all other factors besides the constitution of traffic are the same. Studies of the effect of the constitution of traffic on accidents is one type of problem which highway planners and psychologists can undertake in cooperation.

Driving Reaction Time and Steering Ability

Proper sight distances for hills and curves and for the location of signs can be determined only if we have reliable figures on the reaction time of drivers. It is commonly held that the average driver's reaction time, that is, the time that it takes him to see an emergency and start to apply his brakes, is 0.75 of a second, but this figure is merely an estimate, since sufficient research has never been carried out to determine the reaction time of motorists at the wheels of their cars under widely varying circumstances. Reliable data on this subject are certainly to be desired.

In planning our roads, information is also needed on the ability of drivers to steer their cars safely at high speeds. Such information is necessary in determining for what maximum speeds to plan roads. Accidents commonly attributed to roadway defects are sometimes undoubtedly caused by drivers being unable to handle cars at excessive speeds because of lack of training and experience. The natural limitations of motorists in piloting rapidly moving vehicles is a subject deserving much more attention than it has received.

The Human Causes of Accidents at High-Accident Locations

The value of studying the human causes of accidents at hazardous locations may be seen from the following example. In one state the accident spot map revealed a particularly high recurrence of accidents on a certain stretch of road. A survey of the accident data indicated that most of the accidents were occurring at a number of sharp curves. Recommendations were made to expend considerable funds to widen and straighten these curves, but during the two years which followed, while plans for reconstruction were debated, the accidents on the stretch of road involved fell off to almost nothing. Investigation revealed that a popular roadhouse on that highway had moved elsewhere, and when a check was made of the details of the accidents during the previous years it was discovered that nearly all of them occurred late at night and that most of them could be attributed to drunken driving. In this case the removal of the human cause reduced accidents and saved the unnecessary expenditure of considerable funds to eliminate physical hazards in the highway which had proved to have little to do with the accidents in question. Another corollary of this story might be that highways in the vicinity of roadhouses should be straight and wide if they are to be negotiated successfully.

In another state, in an effort to reduce accidents, a considerable sum was spent on a certain stretch of road to straighten curves and eliminate grades on hills. In order to avoid excessively large expenditures, however, a number of bad curves and grades were left untouched. Contrary to what might have been expected, the accident rate on the new road was higher than on the old one. One of the most important reasons turned out to be that motorists had increased their average speed on the new road with the result that they were trying to negotiate the curves and hills which had not been improved at a far higher rate of speed than formerly. It would seem that, in so far as it is possible to do so, in preference to eliminating only a few of the danger spots, all the hazards on a stretch of road should be eliminated or reduced to approximately the same degree of danger.

An important and often neglected factor in road design is the manner in which the average motorist reacts to various hazards. Thus a steep, winding road will be traversed safely by motorists because it is uniformly risky, whereas a single bad curve in an otherwise safe road may be extremely dangerous because of the higher speeds and less cautious attitudes assumed on it. Similarly the combination of a bad curve, narrow pavement, and slippery road surface may lead to many accidents because such a grouping of hazards is seldom encountered and the average motorist is unprepared to meet such a set of conditions, especially if he has had no warning of them.

Driving Habits

In order to design a safe highway it is desirable to know something about how it will be used. A highway may be safe or unsafe according to the speeds at which it is traveled. With reference to this point Commissioner William J. Cox of the Connecticut Highway Department has said:

> The Merritt Parkway is often cited as an example of how safe a road can be made. Grades are separated; opposing lanes of travel are divided by a wide strip, planted where necessary to decrease headlight glare; sight distances are ample throughout, curves are flat, and are carefully banked, practically everything that the science and art of traffic and highway engineering can provide to make a road safe, has been provided. And the accident experience has been very satisfactory. Here, you may say, is a safe road.
>
> But in addition to the engineering features of the road, note one other thing; speed on the road is limited to fifty miles an hour. That is no more than the speed permitted on the highway system generally. *Moreover, the road is patrolled night and day to see that the speed limit is observed.* The Merritt Parkway constitutes less than one and one half per cent of the state highway

system of Connecticut, but it absorbs about 25 per cent of the state police patrol of our highways.

How safe do you think the Merritt Parkway would be if it were not patrolled? . . .

Suppose there were no more patrolling of the Parkway than there is of the average highway. Is it not reasonable to expect that speeds of the travelling public—or a considerable part of it—would gradually creep up to sixty, to sixty-five and seventy and seventy-five miles an hour? (The police have already made arrests of occasional persons "trying to do better than ninety.") I may be wrong, but I fear that if the Parkway were not adequately patrolled, before six months had passed it might change from being the safest of Connecticut highways to being the most ghastly.

When the highway engineer has gone just as far as he can go and assuming that he has done a 100 per cent job, the result of his work will be a safe road or an accident-spattered road—depending on the use that is made of it. [63, *2*]

Commissioner Cox also pointed out that highway engineering can make a road safe for any given speed; but the very process of making it safe for any given speed makes it travelable at a much higher speed. And at a higher speed the road may be less safe than it was before improvements were made.

The establishment and maintenance of an adequate police force for enforcing a speed limit would seem to be a requisite provision in plans for superhighways of the future.

Since accident statistics indicate clearly that night driving is more dangerous than day driving, it is important for the highway designer to know how the different features of the road will appear to the average driver after dark. All too often the highway designer has in mind day driving only, forgetting entirely that the danger inherent in different elements of the highway increases considerably from daylight to darkness. Sight distances, signs, roadway markings, and a number of other features of the highway need to be considered from the standpoint of how suitable they are for the night driver.

PROGRESS IN IMPROVING CITY STREETS

Our cities, which were laid out at a time when there were no automobiles, now find themselves burdened with traffic for which their streets are not designed. The present multiplication of automobiles on the streets has created such serious congestion and accident problems that city administrations have been obliged to grasp at any methods they could to deal with them. The range of ideas for the engineering improvement

of city streets is very wide, and the literature on the subject is voluminous.*

In the last analysis, however, it must be agreed that little can be done to eliminate the hazards inherent in city streets as they are today. Certainly it is much more difficult to reduce the dangers they present than those of main rural highways. The reason for this is that the gridiron pattern of city streets, producing, as it does, a maximum number of intersections, permanently limits the safe and efficient handling of traffic. Most traffic engineering improvements in cities are makeshift arrangements. Really to solve the urban traffic problem would necessitate redesigning cities by providing an entirely different pattern of streets which would facilitate the flow of vehicular and pedestrian traffic rather than obstruct it.

The problem of city planning is an exceedingly complicated one which could not possibly be covered adequately in the limited space available in this chapter or, indeed, in this book. We shall confine our discussion therefore to a few of the engineering improvements which have proved useful in ameliorating some of the problems of congestion and accidents in cities, admittedly, without offering a basic solution to the situation.

Among the chief remedies for reducing accidents and facilitating traffic movement in cities are the following: (1) rerouting of through traffic, (2) pedestrian control, (3)intersection control, (4) speed control, and (5) street lighting.

Rerouting of Through Traffic

Fast trans-city traffic contributes to many urban accidents. "Through" traffic should therefore be rerouted whenever possible: (1) via an elevated or depressed highway through the city, (2) via a bypass around a city, or (3) via streets little used by pedestrians, away from the heart of the city, from schools, and other pedestrian centers.

Pedestrian Control

Sixty-three per cent of fatal accidents and 41 per cent of non-fatal accidents in large cities involve pedestrians. The reduction of pedestrian deaths and injuries is consequently the most important phase of the accident problem to be solved in cities.

Improving the pedestrian accident rate by physicial change in city streets is limited; the problem of reducing pedestrian accidents is pri-

* Several bibliographies are available which cover important phases of the literature. [294, 295, 296] There are, in addition, a number of individual publications on the subject [116, 117, 118, 165, 173, 174, 206], as well as a valuable monthly review of the literature [130], and an annual collection of pertinent articles. [129]

marily one of administration, education, and enforcement. Nevertheless, the introduction of such engineering improvements as safety islands, sidewalk guard rails, pedestrian underpasses and overpasses, and more traffic lights may help somewhat to reduce pedestrian accidents (see Chapter X for further discussion of the pedestrian problem).

Intersection Control

Since approximately 40 per cent of fatal accidents and 55 per cent of non-fatal accidents in cities occur at intersections it is obvious that the intersection type of accident must be controlled in order to make any serious dent in urban accident rates. The most common way of trying to reduce accidents at intersections is to install traffic signals or stop signs. But traffic lights and signs are of little avail unless they are obeyed. All too often signs and signals are erected without proper public education or police enforcement, with the consequence that both motorists and pedestrians ignore them, and accidents at these points continue unabated. The reduction of accidents at intersections requires more than the mere installation of safety devices. It demands that they be accepted and complied with by the public.

Speed Control

Adequately enforced speed control has drastically reduced accidents in a number of cities (see Chapter III), but as for intersections, the mere erection of signs at proper locations is insufficient unless a follow-up program is instituted to teach the drivers of the community the advantage of slower speeds and to discipline those drivers who fail to hold their speed down to the prescribed rate.

Street Lighting

Since the use of cars in cities at night is on the increase, there is more and more need to light the main thoroughfares so as to benefit the motorist as well as the pedestrian. Current street lighting is usually adequate for the guidance of pedestrians but is of little help to the motorist moving at speeds of 25 miles per hour and over. For the latter, street lights must be bright enough and spaced closely enough together to enable hazards to be perceived quickly and distinctly. Studies made of night accidents before and after the installation of improved street lighting have indicated that considerable reduction in accidents can usually be expected as a result of it. [60]

It is obvious from the preceding discussion that in the immediate future engineering improvements will play a more important part in reducing accidents on main rural highways than on city streets. The reduction of accidents on city streets can for the most part be accomplished more economically and successfully by emphasizing the widespread use of the suspension and revocation authority of the state motor vehicle administrator, enforcement of moderate driving speeds, and education.

The findings of the Planning Surveys that the main rural highways and their trans-city connections carry almost 60 per cent of the total traffic, and city streets only about 33 per cent, together with the well-known fact that travel is faster on through highways, would seem to justify increased emphasis on the material improvement of principal rural highways, including generous expenditures on elevating or lowering through highways across large cities and in constructing belt roads around smaller cities and towns.

America pays a high price in accidents for the privilege of driving fast on its improved highways. Once the public fully realizes that unrestricted driving on improved highways brings more accidents unless speed is controlled, a sentiment for more adequate expenditures for educating and controlling drivers should develop.

CHAPTER XIII

TRAINING AND EXAMINING DRIVERS

In Chapters XI and XII we indicated ways and means of decreasing highway accidents by improving the vehicle and the road. In Chapters XIII and XIV we approach the problem from the standpoint of improving the operator. Chapter XIII will be concerned with the education and examination of the operator prior to licensing him, whereas Chapter XIV will deal with the control and betterment of the operator after he is licensed and using the highways.

I. TRAINING DRIVERS

This chapter will be divided into two parts. The first section has to do with training the driver, and the second section with qualifying him for the license.

THE PRESENT STATUS OF DRIVER TRAINING

The average American's attitude is that "anybody can drive a car." Even when he first applies for a license he is inclined to "get by" with as little experience as possible. This casual attitude, a reflection of our general lack of appreciation of the serious responsibility involved in operating a car, is the reason why so little has as yet been done in training drivers.

Few of us have had any formal instruction in handling a car. The majority have been taught by members of their families or by friends. Father has tried to show Mother and the children, often with disturbing effect on domestic accord, or Sister has persuaded her boy friend to teach her. Occasionally, also, a car salesman will offer to teach his customer to drive in order to facilitate a sale.

As might be expected, this sort of training is far from satisfactory. Often the person who gives the instruction is a poor driver or a poor teacher, or both. The poor driver tends to drill his pupil in all his own bad habits, and the poor teacher confuses his pupil by lack of system in

teaching fundamentals, frequently making his victim so nervous that it is months before he acquires confidence on the road.

There is also a large group of motorists who have taught themselves to drive. Many people who have no friends or relatives to instruct them and who cannot afford to pay for a course in a driving school try it on their own. Adolescent youngsters forbidden by their parents to drive often secretly take out the family car and experiment with it alone. Farmers practice by themselves on little-traveled lanes.

In the early days of motoring, when speeds were low and few other cars were on the road these home-instructed drivers managed fairly well. But with the increased speeds and more congested traffic, more knowledge about how to handle a car and follow safe driving practices is needed.

DRIVING COURSES NOW AVAILABLE

As yet motorists who have taken lessons from professional driving instructors are distinctly in the minority, numbering only a few thousands in comparison with the millions who have had sketchy tutoring by untrained drivers or no instruction at all. Those who have had regular instruction come chiefly from fairly well-to-do classes of persons residing in cities where driving courses are located. There are three types of these courses at the present time: (1) the commercial driving courses for which a fee of $10 is usually charged for a series of lessons; and (2) educational courses in driving conducted by public schools or colleges; or (3) sponsored by governmental agencies like the Works Progress Administration, or the motor vehicle departments, or by automobile clubs.

Commercial Driving Schools

In the majority of cases learning from a commercial driving school is better than learning from one's family or friends. The reason for this is that the commercial instructor has had more practice in teaching people to drive, and also that the pupil, having to pay for his lessons, takes them more seriously. But the objections to commercial driving schools are numerous and cogent. Many such schools are makeshift organizations, staffed by untrained and inadequately paid instructors. Although their courses—usually consisting of 5 or 6 lessons ranging from fifteen minutes to an hour—are better than no systematic training at all, they leave much to be desired. Many such schools limit their road instruction to the local test route, if there is one, and concern themselves primarily with coaching the applicant to pass his license examination. The more vital matter of inculcating proper attitudes and developing good driving habits is almost forgotten.

Driving Courses in Public Schools

It is a commonly accepted educational principle that the sooner you get the pupil the easier it is to mould his attitudes and the more lasting is the effect of your training. It follows, therefore, that the time to start safety training for beginning drivers is early, as soon as the youngsters are old enough to be eligible to drive cars.*

In most states drivers must be at least 14, 15, or 16 years of age before they can be issued licenses. [9, *22*] Since compulsory education up to 16 years is the rule in the majority of our states, a large number of students continue in school up to this age. Thus an excellent time to begin the training of youthful drivers is during high school.

There are two important aspects of safety work in the schools: (1) classroom instruction covering traffic laws and motor vehicle regulations, good driving habits, accident statistics, and a number of other points related to driving; (2) actual driving training on the road.

Classroom Instruction in Highway Safety. All together over 7,500 high schools in the United States include classroom instruction in highway safety in their curricula, and the number is rapidly increasing. [12, *242*]

Classroom safety instruction of adolescent students when well handled by capable teachers nearly always has beneficial results. Its success, however, depends almost entirely on the teacher. If safety is presented in a preachy, moralizing way the effect on the adolescent student may be to encourage him to react in the opposite direction. If safety is to be taught to high school students it should be taught with a minimum of "don'ts" and "mustn'ts." Lessons should be factual, informative, and interesting.

In one state a check was recently made on the accident records of students who had taken safety courses at a number of high schools. The results showed that students who took highway safety instruction courses that were given by properly trained teachers had better accident records than the average of young people of that age. But the students who took safety courses that were taught as a matter of routine and without trained teachers, had poor accident records, in some cases worse than students who had no training whatsoever. Other studies comparing the accident rates of students who have undergone classroom instruction in safety with those of other students who have not are needed.

Safety lectures are an ideal way to teach motor vehicle laws and regulations and to prepare students to take the state law test. However, they can never produce the same effect alone as when linked with road training.

* Instruction in safe pedestrian practices should, of course, be given to the very youngest pupils.

Actual training at the wheel of a car is just as necessary to classroom discussion of safe driving as laboratory work is to lectures in physics or chemistry. Road instruction enables the student to apply the theories and principles presented to him in the classroom. Whenever possible, therefore, highway safety lectures should be accompanied by road instruction. [17, 29, 216, 291]

School Road Training. Approximately 600 high schools now offer regular driving training along with driver education courses. [12, *242*] Road training is not more widely given because it is relatively costly. As against $2 to $3 per pupil for classroom instruction, road training costs on an average of $12 to $15 per pupil. Some road training courses are reported to have cost as little as $6 per student and others as high as $25, but adequate training of this kind can usually be given for around $15 per student.

A knotty problem which must be solved before road driver training in the public schools becomes the rule is "Who should pay for it?" Should it be paid for by the public schools, by some other governmental agency, or by the individual student?

The American Association of School Administrators in its eighteenth *Yearbook* entitled "Safety Education," says in answer to this question:

> If streets and highways are to be peopled with competent motorists, the community must insist that all new drivers be given actual "at the wheel" instruction. This is a community responsibility. . . . There are good reasons why the secondary school should play a part in the driver-training program. If the school accepts the responsibility for driver education in the classroom, it is logical for it also to provide driver training upon the road. The two go together. Each are necessary parts of a complete whole. Furthermore, there are advantages in having the same teacher teach both to the pupil. In this way one can be made to supplement and implement the other and best results will be achieved. [12, *155*]

It is obvious that people can be trained to handle motor cars proficiently just as they can be taught to do anything else. A question frequently raised, however, is: "Does road training actually reduce accidents?" Unfortunately, few figures can be cited to show the effect of road training on accidents. Amos E. Neyhart of Pennsylvania State College recently made a study of two groups of drivers. One group of 250 had taken a course in driving at the college; the other group of 250 had not taken any course, but had learned to drive by themselves, or had received a few haphazard lessons from friends or relatives. The untrained drivers had 13 accidents, in 9 of which they were found to be at fault. The trained drivers were involved in 5 accidents and were at fault in only 2 of them. There were 11 personal injuries among the 13 accidents of the untrained

drivers and no personal injuries in the 5 accidents that the trained drivers had. This study, which cannot, of course, be regarded as conclusive, owing to the small numbers involved, would seem to indicate that it pays to train drivers. Trained drivers had fewer accidents, and the accidents they did have were not so serious as the accidents incurred by untrained drivers.

The effectiveness of driver training obviously depends on the adequacy of the teaching. More research is needed to collect information on the accident rates over a period of years of graduates of driver-training courses and the types of accidents they incur. Data of this sort would furnish invaluable material for improving the teaching method and content of the courses, and give a better idea than we have at present of the relative effectiveness and cost of driver training as compared with other methods of controlling accidents. Driver training would appear to be something we cannot afford to be without. Figures, however, speak louder than words, and further studies of the effectiveness of driver training in schools are needed. [2]

The Neyhart Driver-Training System. The driver-training plan most widely used in secondary schools was developed by Neyhart at Pennsylvania State College. According to this plan pupils practice in cars in groups of four students and an instructor. The amount of time required to make proficient drivers varies, but normally it takes about 32 hours. Of this time the student spends 24 hours riding in the car observing, and 8 hours at the wheel. It is estimated that each student drives at least 72 miles and rides as an observer three times that far. Although the student does not learn so fast when riding as an observer as when he is behind the wheel, it has been found that the time devoted to observing the mistakes of others is distinctly valuable.

Neyhart recommends the use of dual-control cars. The extra control consists of auxiliary clutch and brake pedals which enable the instructor to assume charge of the car instantly if necessary.

A practice street comparatively free from traffic is used. Ideally this practice street should be appropriately marked with crosswalks, parallel and angle parking lines, and a center line. It should include a grade, and provisions for right and left turns. It is also helpful to have various types of traffic signs and traffic lights available.

The following topics, in the order given, are taken up in the Neyhart program: [12, *157 ff.*]

1. The driver's compartment.
2. How the automobile runs.
3. Check-up on the car and the driver. Starting the engine.
4. Steering, and stopping car from low gear.

5. Shifting from low to second gear and stopping from second gear.

6. Shifting from second to high gear and stopping from high gear.

7. Starting the car in low gear, then shifting to second and on to high gear within a prescribed time and distance, and stopping the car from high gear. Steering in a straight line with the left or right wheels on a line. Stopping the car suddenly. Using the proper hand signal for stopping on the street or highway. Weaving between stanchions.

8. Shifting from high to second gear and shifting from second to low gear. Making emergency stops.

9. Backing, steering, and stopping in reverse gear. Backing the car into a prescribed location. Weaving backward between stanchions.

10. Making right- and left-hand turns and using correct hand signals before the turns are made.

11. Turning the car completely around.

12. Parking in a short space between other cars, and angle parking.

13. Stopping and starting on an upgrade, backing on an upgrade, parking on an upgrade and downgrade.

14. Open-highway driving.

15. City driving.

16. Driving-skill tests.

The Lane Technical High School of Chicago Driver-Training Course. Another interesting development in driver training is the work begun in 1936 of William Sears in the Lane Technical High School in Chicago. [249] Third-year students, usually 16 to 18 years of age, are required to spend an hour and a half a week for eighteen weeks in the driving course, which is a regular part of the school curriculum. The course is divided into three parts:

1. Six hours are spent studying safe-driving rules and motor vehicle regulations.

2. Seven and a half hours are spent training the students in the proper manipulation of the car controls, using dummy cars in the classroom. The clutch, brake, and accelerator pedals and different gear positions are wired to a panel of electric lights in the front of the class. When a beginner fails to do the right thing at the right time, his mistake is indicated on the panel.

3. Thirteen and a half hours are devoted to actual driving practice on a specially built course which simulates city traffic conditions. The average student learns to drive after covering 22 miles on this course.

The use of dummy cars in this course helps to reduce the time required for the actual driving instruction. In these dummy cars the student learns not only to operate the controls but to react correctly to traffic situations as depicted by moving pictures on a screen. It is estimated that the total cost per student of high school age, including the cost of instructors, equipment, and other necessities, does not exceed $3 when the Lane Technical High School method is used.

Non-Profit Courses for Drivers Outside the Secondary Schools

High school training for drivers is becoming more and more common. It promises to be one of the most important factors in the future in reducing accidents among the annual crop of new drivers. [132] But high schools cannot by themselves solve the problem of training all new drivers. Approximately only one person out of two remains in high school long enough to be graduated and since driver training is ordinarily not given until the senior year, it follows that a *great many young people would not receive adequate driver training even if all the high schools of the country were to offer such courses.* Other means besides high school courses must be provided to train beginning drivers.

Private driver-training schools, if improved, may make a considerable contribution. One state, New York, now licenses these in an effort to improve their standards of instruction. The state reserves the authority to take away the licenses and thereby can effectually curb any school that is doing a slipshod job.

Several different types of non-commercial groups have also attempted to comply with public demand by offering training courses for adult drivers. One is the public or private school or college. Another is the state motor vehicle department, and a third, the Works Progress Administration.

New York University affords an example of the first type of organization. It offers a course in driving training as a part of its adult education program. This includes classroom instruction and also practical "at-the-wheel" training. Considerable numbers of adults have welcomed the opportunity to take this training under the tutelage of expert instructors. [300]

Among motor vehicle departments those of Connecticut, New Jersey, and Oregon each devote the time of two or more employees to organizing and conducting short courses for beginner drivers at changing localities throughout their states.

The Works Progress Administration also has financed a number of driver training schools in different states. A typical example is that sponsored by the Pennsylvania Motor Police. All together there are 51 separate schools scattered throughout the state employing 234 WPA teachers. Out of 4,100 graduates only 21 are reported to have been involved in accidents, which all have been minor ones involving only property damage. [12, *205*]

THE TRAINING OF DRIVING INSTRUCTORS

Amos Neyhart conducted the first training course for teachers of driver training at Pennsylvania State College in the summer of 1936. By the summer of 1939 more than 40 colleges were offering this specialized training and it is now on the regular curriculum of several colleges.

A brief description of Neyhart's course follows:

A class of beginners in driving (preferably knowing absolutely nothing about driving) is solicited from a nearby community. In the classroom work, these beginners constitute the class to be taught. They sit in the front of the room. The student teachers sit in the back as observers. As they become accustomed to the work, they may be called upon to conduct the class in some units.

Road work with the teachers is begun at once. The instructor takes each teacher out individually and observes his driving. He points out objectionable practices and prescribes accordingly. The student then is expected to bring his own technic up to standard. A schedule of use of cars must be constructed so that the afternoon can be profitably used, if the class is held in the morning.

By the middle of the second week the beginners' class will have covered the classroom work on "How to Drive," written test and all, and the student teachers will have taken their road tests. If bad driving practices still persist or the tests are not passed, each individual takes all of them over again. The preparation and testing of the teachers mean unlimited work for the instructor but the results are worth the effort. Unless the work is divided between two instructors, this course alone is all that can be handled in the session.

The beginners are now ready for their road training and the student teachers are prepared to do their practice teaching with them. A requirement for passing the training course is that each student teacher successfully train at least one beginner (that means the passing of all the tests by his pupil). As the tests are far more difficult than any state examination for license, the beginner should be able at the conclusion of the college course to pass the state examination and get an operator's license. . . .

When the beginners have completed the unit on the driver—his physical, mental, and emotional characteristics—they and the student teachers take a number of laboratory tests. . . .

Deficiencies which might affect driving are discovered through the administration of individual tests and correction may be made then, or compensations built during the training period. While a totally deaf person will already have formed compensations which will function in driving, a partially deaf person may not even be aware of his deficiency until he is given a test. He will have to learn to compensate for his disability, e.g., by closer watching of other drivers' actions and greater precautions.

If the student teacher in driver education goes through the entire series of road lessons himself, completes all the road tests, skillfully teaches at least one pupil to drive intelligently, he may well be expected to make good in one of the most difficult of training professions. If the instructor is certain that the student lacks a pleasing and patient but firm personality or other desirable character attributes he should not encourage the student teacher to go on in the driver-training field. [12, *263*]

New York University has recently set up a Center for Safety Education under the leadership of Herbert J. Stack. The purpose of the Center is to prepare teachers in the field of safety—highway safety, home, farm, and industrial safety. It offers regular courses for students working for advanced degrees and has available a number of scholarships for college graduates who intend to specialize in this field. In addition there are also adult education courses for persons not interested in college credits. In the summer, the staff of the Center aids in conducting short-course safety-training classes in summer schools throughout the country.

THE COST OF DRIVER TRAINING

The principal reason why cities and states have hesitated to assume the burden of driver training is the large number of drivers to be trained and the cost involved. In one year the number of new drivers applying for a license amounts to about one-tenth of the total number licensed. In a state like Connecticut with approximately 450,000 drivers, the number of newly licensed drivers comes to about 45,000. But since in Connecticut about half of the new applicants for a license are already experienced drivers, the number who require training comes to approximately 22,500. At $15 each the total expense to the State of Connecticut to train its crop of beginner drivers would be $337,500. Although the third of a million dollars sounds like a great deal of money, it actually comes to only one-fifth of the amount collected annually by the State Motor Vehicle Department for operators' and chauffeurs' licenses, or one-twelfth of the money collected for registration of vehicles, or one-twentieth of that collected for all the state's motor vehicle and driver fees and receipts.

Thus the cost of state driver training, although it looks impressive at first glance, actually is little in comparison with the revenue derived from motor vehicle owners. It is still smaller compared with the cost to the state of accidents primarily attributable to faulty driving. In the opinion of most motor vehicle administrators savings from reduction of accidents by effective training of drivers would more than pay for the cost of such training.

II. EXAMINING DRIVERS

THE PRESENT STATUS OF EXAMINING DRIVERS

Driver training is fine in theory but hard to "sell" to drivers. The average American motorist regards his driver's license as an official authorization of his status as a qualified driver. Under the present circumstances, therefore, whatever training is regarded as desirable must be required of him before granting him a license.

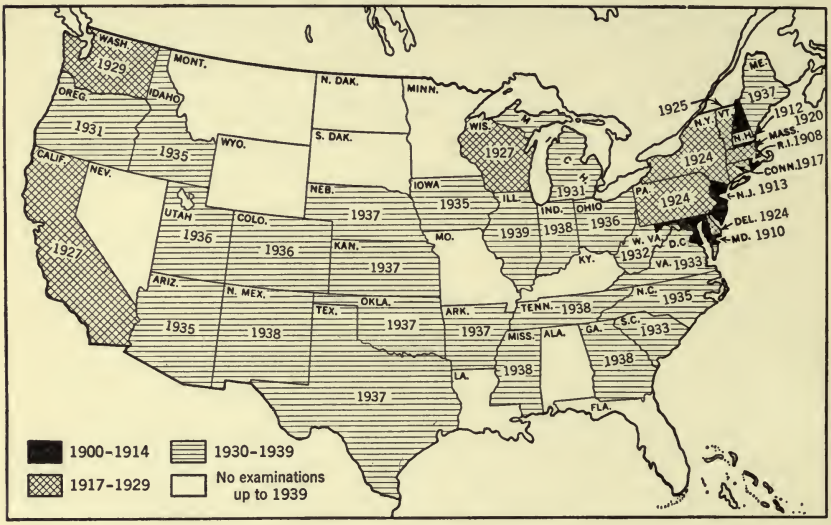


Fig. 49. Map showing years automobile drivers were first examined in the various states.

Source: *Minimum Driver License Examination Standards*, p. 10. American Association of Motor Vehicle Administrators, Washington, D. C., 1939.

An important reason why driver training has lagged in many states is that prospective drivers have been able to procure licenses with little or no instruction. The only certain way of inducing beginners to undertake a course of training is to make the examination for a driver's license so difficult that they have to go to school in order to pass it.

The examination standards for granting a license are thus of fundamental importance to determining the amount of training that prospective drivers have to undergo to obtain it. Where the license standards are high, prospective drivers have to practice and study hard to master the road test and motor vehicle regulations, whereas in those states in which license

standards are low, prospective applicants naturally put forth only the minimum amount of exertion necessary to obtain that license.

In view of the importance of the driver examination in the whole driver education program, it is particularly unfortunate that the examination of drivers is so backward in many states. Three states (Louisiana, Wyoming, and South Dakota) do not even require drivers to be licensed. Six other states (Florida, Montana, North Dakota, Nevada, Minnesota, and Missouri) give no license examination. Of the remaining states about half give a sketchy, hurried examination. Not more than 15 or 20 states give a fairly strict, comprehensive license examination.

Figure 49 indicates that driver licenses are of fairly recent origin. Twenty-six states began examining drivers during the last decade, and of these only 5 had instituted examination systems prior to 1935.

PRESENT-DAY DRIVER EXAMINATIONS DESCRIBED

The typical current driver examination in more progressive states includes the following tests: (1) road signs, (2) vision, (3) law, and (4) road driving.

The *road sign test* is designed to find out whether the applicant can read and understand the road signs that he will encounter on the highway.

The *vision test* aims at testing the candidate's general visual efficiency with the view to requiring him to have his eyes corrected if his vision is not up to the required standard (see Chapter IV).

The *law test* is intended to test the applicant's knowledge of the state's motor vehicle laws and the rules for safe driving upon which they are based (see Chapter V).

The *road test* is designed to determine the operator's ability to handle a car skillfully. Note is made of his attitude toward the public and his understanding of driving hazards (see Chapter IV).

When efficiently administered the four tests listed above should:

1. Determine the operator's ability to comprehend road signs.
2. Require correction of faulty vision.
3. Test the examinee's knowledge and understanding of traffic laws, of driving rules and regulations, and of safe driving practices.
4. Test his ability to handle his car with reasonable skill, thus ensuring adequate training on the part of new drivers.
5. Impress upon the operator the fact that driving is a privilege.
6. Give the applicant an appreciation of his responsibilities to pedestrians as well as to the motoring public.
7. Weed out physically defective and incompetent and irresponsible candidates.

RECOMMENDED IMPROVEMENTS IN DRIVER EXAMINATIONS

At the request of the American Association of Motor Vehicle Administrators the Driver Research Center at Yale recently worked out a set of license examination standards. [6] It was hoped that these standards would (1) aid the states in improving the efficiency of their driver examinations, and (2) contribute to the uniformity of driver examinations in the different states and within individual states.

The standards which were developed represent a composite of the best practices of motor vehicle departments in the United States. They have been officially approved by the Association of Motor Vehicle Administrators and recommended for adoption by the states. Already over a dozen states have endeavored to improve their examinations so as to meet the recommendations made.

In addition to adequate examination standards the efficiency of a driver-examining system depends on:

1. Capable and well-trained examiners.
2. A properly supervised and uniform examination.
3. Suitable examining facilities.
4. A good driver manual.

Capable and Well-Trained Examiners

A number of state motor vehicle agencies permit examinations to be given by persons not under their direct supervision. These unofficial examiners include county clerks, sheriffs, state police, municipal police, and even automobile club representatives, insurance agents, eye specialists, and private citizens. Needless to say, no state can expect the best results from examiners who are not properly trained and employed directly by the state department in charge of licensing drivers.

Nevertheless the status of license examiners even in those states that give them full-time employment is most unfortunate. They are nearly always underpaid and overworked. In a number of states, examiners are political appointees and frequently show little aptitude for, or interest in, their work.* Since examiners are not on civil service, in many states

* An outstanding exception to the general rule is the state of California. Its examiners are civil service and are selected from applicants who are able to demonstrate education equal to completion of two years' college work, including a course in elementary psychology; and five years' experience in responsible work involving broad public contacts; or some other equivalent combination of education and experience. From the applicants meeting these requirements, the most likely candi-

when a political change occurs all examiners are thrown out of their jobs to make way for the appointees of the incoming political party. Only a handful of states require their new examiners to undergo a regular course of training, whereas refresher courses for experienced examiners, such as are common among police organizations, are almost unknown among motor vehicle departments.

Where state police do the examining, all too often the positions of examiner are given not to the men with the best qualifications, but to elderly patrolmen just before they retire, to men injured in performance of their duties, or to raw recruits. Moreover, since the opportunities for advancement are fewer in examining than in criminal or patrol work, the average ambitious patrolman dodges the job of examiner, or serves his term, and transfers to other work as soon as possible.

An efficient examination system grows out of the daily efforts of individual examiners. They should be under the direct supervision of the state motor vehicle department. Improvement in their efficiency and morale is contingent on:

1. A reasonable tenure of employment pending good behavior.*
2. Adequate salaries to attract men who are capable of developing a professional point of view toward the job.
3. A promotional system providing for gradual increases in salary and rank to hold high caliber men on the staff.
4. Adequate traveling and per diem expenses when working away from home.
5. Unvarying support from the administrator in handling controversial questions which arise in the field. The examiner should have assurance that his superiors will investigate all complaints impartially and that unjust complaints will be recognized as such.

A Properly Supervised Uniform Examination

Examinations vary in character from state to state and from examiner to examiner within a state. Thus in some states one out of a hundred persons fails the road examination; in a few states one out of three fails on first appearance. Just as striking is the fact that in some states with a low minimum visual acuity requirement, more applicants are failed for defective vision than in other states where a higher standard is required.

dates are then chosen by means of an examination consisting of (1) a practical written test; (2) education, experience, and fitness ratings; (3) estimates of personal traits; and (4) a medical examination.

* Motor vehicle departments are under civil service in less than one-quarter of our states.

Even within a department there are wide divergencies in the strictness of individual examiners, as will be seen from the figure below.

Notice that some examiners (G, H) rejected many applicants on the law tests but were more lenient on the road test. Others (L, M, N, S) were very critical of performance on the road test, but passed most applicants on the law test. Some examiners (D, E, F, O, P), on the other hand, were lenient on both tests, whereas one examiner (I) rejected a relatively high percentage of applicants on both tests.

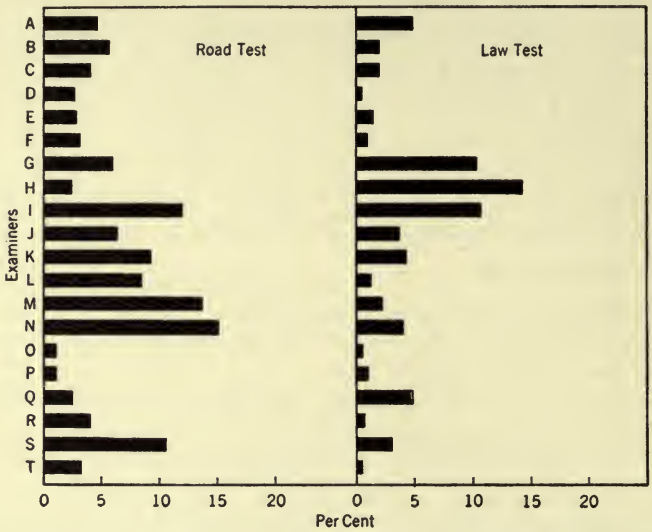


FIG. 50. Variations in license examination rejections by different examiners in an eastern state.

Source: *Driver License Examination Procedure,* p. 59. American Association of Motor Vehicle Administrators, Washington, D. C., 1940.

In order to ensure standard practices among all examiners at all points in a state it is necessary that the examiners be well-trained and well-supervised. A written procedure covering the most essential rules and regulations for an efficient and uniform administration of the license law should be available to them at all times. For states wishing to prepare their own state procedures, the Standard Driver License Examination Procedure approved by the American Association of Motor Vehicle Administrators furnishes a long-needed guide.

The advantages of strict, uniform, state-administered license examinations are many. Most important, they teach the public to respect the department and its examiners and impress on it the fact that it is a privilege to drive. Applicants must have had considerable practice on

the road to pass such examinations; they must have studied state motor vehicle laws and traffic regulations; and remedied their eyesight, if it has been found defective. Flagrantly incapable drivers are thus eliminated at the outset, before they can inflict injury on the person or property of others.

Suitable Examining Facilities

In many states the eye test and law test are given in crowded rooms where disturbances are at a maximum. In fact in some states no inside quarters of any kind are available so that the examiner has to give the written or oral parts of the examination out-of-doors. Such conditions of course are not conducive to the best results. Examiners need privacy and freedom from distraction if they are to give careful examinations. And without constant illumination no department can expect to give uniform eye tests.

Road tests also need suitable locations, but in most states little care is taken in picking them out. The Association of Motor Vehicle Administrators recommends that at least two standardized road test routes be laid out at each examining point. The courses should be from one and one-half to two miles in length and comprise enough items for the driving test to last from twelve to fifteen minutes. There should be included in the test course a straightaway on a little-used street on which to demonstrate backing, turning about, and parallel parking; also several turns; an assortment of signs and signals; if possible, a hill for starting and stopping; and sections of both business and residential districts. Unless proper driving courses are available at all examining points it is useless to expect examiners to give a strict, uniform road examination.

A Good Driver Manual

Although about 36 states now require all new applicants to take an examination on motor vehicle laws, only about a third of these states give beginners a simple, clearly written, comprehensive booklet containing the material on which the questions are based. Most motor vehicle laws are written in such abstruse language that unless they are interpreted and expressed in simple language the average driver will never read, much less understand, them.

At the request of the American Association of Motor Vehicle Administrators the Yale Driver Research Center has drawn up for state motor vehicle departments an illustrated driver manual which contains, in addition to the common fundamental motor vehicle laws and regulations, the minimum essential material about safe driving practices. [7] Ten states

have already adopted this manual, or revised their old manual along the lines recommended. As additional states adopt this standardized driver manual it will help to make examinations for drivers more and more uniform throughout the country by providing all drivers, no matter what state they may come from, with the same minimum essential information about traffic regulations and safe driving practices.

Ignorance of traffic regulations and sound driving practices are important sources not only of confusion but also of accidents, to whose reduction education through a standardized driver manual should noticeably contribute.

OTHER SUGGESTED IMPROVEMENTS IN EXAMINING DRIVERS

Besides a better examination for beginner drivers, two other important improvements are needed in our present state examining systems. One is to set up a re-examination technique to reach licensed drivers who have never been examined. The second is to exert a closer supervision over inexperienced operators during their first year or two of driving.

Re-Examining Drivers

A little-known fact about our present group of drivers is that approximately 60 per cent of them have never had their ability to drive investigated. The reason for this is that whenever driver license examination laws were initiated in states, to ensure the passage of the bill, a "grandfather clause" was always included exempting from examination all persons then operating vehicles. As a consequence, since most states did not start to license and examine drivers until quite recently, the majority of licensed drivers have never had to take an examination, and hence have never been required to master the motor vehicle and traffic regulations, to have their eyes examined, or to have their skill at manipulating motor cars investigated. [9, *10*] That this great mass of drivers who have never taken a driving examination regard the operation of an automobile not as a privilege, but as a right quite as inalienable as "life, liberty and the pursuit of happiness," is therefore understandable.

But if we started now to require all drivers applying for a license to complete a strict course of instruction, it would take a couple of decades at least before the majority of the millions of drivers on the road today, who have never been examined or properly trained, would have retired and been replaced by properly trained operators. For this reason we must not expect too quick results from present driver-training programs which influence only a small annual crop of beginners. Along with

educational efforts directed at beginners we must at the same time give consideration to the problem of re-educating the great bulk of motorists who personally consider that they need no further training.

How are the states meeting the challenge of the untrained licensed driver? To reach these drivers they are trying out at the present time three different types of re-examinations:

1. Re-examination of elderly drivers.
2. Re-examination of drivers who have incurred accidents or serious violations.
3. Periodic re-examination of all drivers every few years.

Re-Examination of Elderly Drivers. Two states, Delaware and Maryland, are reported to require a re-examination on the road, vision, law, and road sign tests of all elderly applicants renewing their licenses. One state places this age at 60 and the other at 65. The educational value of an examination of elderly drivers cannot be denied, but, owing to the small proportion of accidents in which elderly drivers are involved, such a re-examination program can never play more than a minor role in reducing accidents. Moreover, unless other groups of persons are also re-examined, the re-examination of elderly persons may, as it did when it was tried out for a short time in Massachusetts, arouse popular resentment.

Re-Examination of Drivers Who Have Had Accidents or Violations. Several states re-examine drivers who become involved in repeated accidents. Other states are attempting a systematic re-examination of all drivers who incur a serious accident or violation.

The fact that a person has had an accident or has committed a serious violation justifies the state in requiring a diagnostic and educational re-examination for the driver's own future self-protection as well as for the protection of other users of the highway. The finding that groups of drivers in accidents on the average rate lower in skill, vision, and in various other abilities than comparable groups of non-accident drivers is another strong argument for this type of re-examination (see Chapter IV).

Periodic Re-Examination of All Drivers. Three states, California, Oregon and Washington, now require all drivers to submit to a periodic re-examination of their eyes. Two of these states require this visual checkup every three years, one gives it every four years. In California, the examiners at their discretion may also administer the road, law, or road sign reading tests at this re-examination.

Complete periodic examination of all drivers at intervals of about five years would go a long way toward improving the safety-mindedness as

well as the proficiency of the majority of drivers on our roads today (see also Chapter XIV, p. 315).

Special Beginners' Licenses

Since inexperienced, youthful drivers are more accident-prone than their elders (Chapter IX), any reasonable means available to improve their group driving records should be put into operation.

The state of Indiana has tackled the problem of youthful drivers in a new way, by refusing to issue them a regular license until after they have driven for a year without incurring a violation or accident. After passing the regular state license examination, application for which must be signed by a parent or guardian, beginners are issued a special license. This certificate is printed in green ink to remind the youngster that he is a freshman at driving. It is good for one year. If at the end of that period the owner has a perfect driving record he is granted a regular license; otherwise he must continue to use his green license until he can go a whole year without a violation or accident.

Since this type of a beginner's license has been experimented with, the number of accidents involving young, inexperienced drivers in Indiana is reported to have been significantly reduced. The idea of a beginner's license is a good one and deserves wider application.

THE COST OF THE DRIVER EXAMINATION

Although the cost of administering the driver examination varies considerably from state to state depending upon the scope of the examination, the number of examiners employed, the salaries paid, and other factors, it is estimated on the basis of figures worked out by a few states that an efficient driver's examination or re-examination can be given for approximately fifty cents per person, much less than the cost of state driver training ($15 per driver). Strict examinations are equally as essential as driver training; in fact neither is complete without the other.

Most of our states have been penny-wise and pound-foolish in neglecting to appropriate sufficient money for driver examinations. In addition to the failure of state legislative agencies to appreciate the importance of driver examinations, a factor of considerable importance in limiting the appropriations for driver examinations has been the policy in many states of not charging a separate fee for the examination. Only seven states make a separate charge for the examination.

States which do not charge the applicant for his examination generally adopt the short-sighted policy of requiring the licensing agency to get

along with as little money as possible. Even in those states which charge the applicant enough to pay for the examination it is not stipulated that such fees be spent specifically on the examination. Better examinations would undoubtedly be given if applicants were charged a fee adequate to cover the cost of a thorough examination, and the money were used solely for that purpose. The important thing, however, is for states to allow the licensing department sufficient money to give efficient examinations and re-examinations, regardless of whence the funds are derived.

AGENCIES WHICH SHOULD ASSUME THE RESPONSIBILITIES OF TRAINING AND EXAMINING DRIVERS

Considering its position of leadership in the use of the automobile and in the construction of modern highways, it is strange that the United States is so backward in the training and examination of its drivers. It is high time we put into operation systematic training and strict examining of all drivers to curb the excessive national waste in avoidable highway accidents.

Three important groups of drivers especially need training: (1) the adolescent youth; (2) the adult who is learning to drive for the first time; and (3) the licensed adult motorist who has demonstrated his inability to drive safely by incurring accidents and violations.

It is up to our community and state educational systems to include in their curricula courses designed to prepare youthful drivers to handle motor vehicles.

It is less clear as to the most logical agency to train the adult who wants to learn to drive for the first time. The cost of any extensive program for adult training would have to be borne by the community, the state, the federal government, or by the would-be drivers themselves. As it is unlikely that the majority of adults will ever be willing or able to pay for their own driver training, the most feasible way would seem to be for the state to offer free driver training as a prerequisite to passing a strict state driver license examination.

A problem of equal importance is the improvement of those drivers who have demonstrated their inability to operate safely by a record of accidents and violations. Requiring all such drivers to take a special course of training, plus an examination at its completion, would undoubtedly go a long way toward improving the accident record of experienced drivers.

CHAPTER XIV

CONTROL OF THE LICENSED DRIVER

An individual motor vehicle accident usually is composed of a series of circumstances, which all must be grasped if one is to comprehend the accident and figure out what could have been done to prevent it. In the same way, the problem of regulating drivers has many angles, which need to be studied and fitted one with another if our public officials are to work effectively to achieve the desired goal of consistently and permanently reducing accidents.

Driver management has as its purpose, the employment of suitable governmental measures to obtain as good drivers as possible. The focal point around which all activities concerned with accomplishing this should be centered is a properly administered driver license law. Without such a law no state has the necessary foundation upon which to build an efficient driver control program.

The primary reasons for compelling citizens to take out licenses to drive is to ensure first, that they are properly qualified, and second, that after being licensed, they will respect the rights of others and regulate their conduct with such good sense as to merit the continuance of the privilege.

Notwithstanding the fact that the state control of the driver is based on the licensing authority, the full possibilities of this authority are seldom fully realized. For this we have our motor vehicle and police departments, our courts, and ourselves to blame.

Motor vehicle departments often do not give due consideration to what should be their main goal—the prevention of highway accidents. Too many departments confine their activities to carrying out their minimum responsibilities of selling licenses and registering cars,* to the neglect of activities of selecting and training new drivers and of supervising licensed drivers.

The police do not in all localities take full advantage of their powers to apprehend transgressing drivers under the motor vehicle law, for

* The Massachusetts Registry of Motor Vehicles, for example, collects some ten million dollars annually and spends only one million. This revenue aspect tends to submerge driver regulation which should stand first.

various reasons, some of which we are about to discuss. And often the courts and judges do not function to punish swiftly, surely, and impartially, as they must if proper respect is to be bred for motor vehicle regulations. The public, also, is often at fault for disregarding personal inconveniences; it must stand actively behind the licensing authority's efforts if conditions on our highways are to be improved.

MEASURES NEEDED TO ENFORCE THE DRIVER LICENSE LAW

Among the most important of the various measures employed by progressive states to enforce the driver license law are the following:

1. Restriction of driving to legally authorized operators.
2. Apprehension of drivers violating traffic laws and safe driving practices.
3. Constructive supervision of drivers.
4. Enforcement of accident-reporting requirements.
5. Maintenance of permanent, easily accessible records of violations and accidents.
6. Punishment of traffic offenders to fit the offense committed.
7. Rewards for good drivers.
8. Re-education of incompetent drivers.
9. Winning public support for improved driver control methods.

Restriction of Driving to Legally Authorized Operators

Besides taking care to ensure that all new drivers are properly trained and required to pass a stiff qualifying examination (as outlined in Chapter XIII), it is necessary to keep a continuous check on all persons using the highways to be sure that legally unauthorized and incompetent persons are prevented from driving. Two types of drivers now using the highways who must be removed are (1) the unlicensed driver and (2) the illegally licensed or wilfully law-evading driver.

The Unlicensed Driver. The requirement that all cars carry registration plates in plain view makes it fairly easy to detect unregistered vehicles.* But since it is not reasonable to require drivers to carry similar visible means of identification,† it is easy for unlicensed persons to drive

* Florida has always required only one plate. To conserve metal for war purposes a number of states have started to issue only one plate.

† In Great Britain, where permanent registration plates are used, the current year's registration is carried in a little pocket on the windshield of the car. Nowhere, so far as the author knows, is the driver's license required to be displayed on the car, although some such scheme of using a transparent holder on the windshield for the license might be devised to make it easier for police to check driver licenses, and also to remind holders to carry them each time they drive.

cars without detection. In fact, cases are continually being reported of motorists who have driven for years without licenses before being caught. The chief factor which deters the average motorist from driving without a license is the chance that in case of accident his inability to produce a license may be held against him. Apart from accidents, drivers are rarely requested to show their licenses.

Hundreds of thousands of unlicensed drivers are operating motor vehicles in the United States, including the legally unlicensed drivers in the no-license states of Louisiana, Wyoming, and South Dakota. A common type of unlicensed driver is the careless person who forgets to renew his license on time and who keeps on driving for several weeks or months with a lapsed license. Another is the over-thrifty person who purposely goes as long as he can without paying for a license. Still others are the youthful drivers who will not wait to drive until they attain the prescribed age, and the learner who makes use of a car without an accompanying instructor before he has passed the qualifying examination. These careless, parsimonious, underage, and insufficiently experienced drivers who have no licenses need to be forced to obey the law. They continue to drive without licenses in most cases solely because there is insufficient enforcement of the driver license regulation. If they knew the police might require them to produce licenses at any time they would no longer dare to defy the law.

Much more serious is the case of motorists who drive after their licenses have been suspended or revoked. That there are numerous individuals who continue to drive after they have forfeited their licenses because of serious violations has been demonstrated on numerous occasions when state-wide checks have been made of the possession of licenses by drivers using the highways. The most logical remedy to this situation is to make the police responsible for keeping active files of the names of persons within their jurisdictions whose licenses have been suspended or revoked, together with the registration numbers of the cars these persons own or customarily drive, and for checking the files regularly to prevent such persons from operating their own or any other motor vehicle during the period of their license suspension or revocation. One of the most important things we should accomplish by reducing the number of unlicensed operators, who have an additional incentive to flee from the scene of an accident, would be to help lessen the number of hit-and-run motorists.

The Illegally Licensed Driver. The reasons why considerable numbers of incompetent and improperly qualified persons use motor vehicles freely in America today are that (1) driver licenses are too easy to ob-

tain, and (2) too little supervision is exerted over drivers after they are licensed.

In addition to the low license examination standards in many states (see Chapter XIII) other undesirable features of our driver license examination are the possibility of bribing the examiner, and the ease with which a dishonest person can have a substitute take the examination or procure a license under an assumed name and a fictitious address. State officials should insist that applicants apply in person for their licenses, and that each applicant's appearance checks with the personal description on his license. To corroborate the correctness of the address furnished, each license certificate should be mailed to the address given, rather than be delivered to the applicant in person.

The most elaborate attempt at identifying each driver with certainty has been made by Dr. Israel Castellanos, Director of Cuba's Bureau of Criminal Identification, who also has charge of driver licensing. He has insisted that all Cuban drivers have their photographs and fingerprints on their licenses. This requirement makes it possible to check every applicant against the central criminal file and prevent any criminal illegally at large from obtaining a license to drive. It also enables the department to identify drivers who have failed to settle judgments against them for accidents and who customarily adopt aliases to get a license. The practice also permits Castellanos to keep check on the location and use of vehicles by petty lawbreakers and criminals who have served their terms. That the need for a workable system of identifying drivers by means other than signature and verbal description is recognized in this country is indicated by California's use of fingerprints, and Illinois's use of photographs, on the license.

The task of checking on the legality of the licenses of drivers using the highways is primarily a police and highway patrol job. It is one that demands the closest cooperation between the state motor vehicle department and the municipal and state police. With the exception of yearly license checkups shortly after the annual renewal of licenses and registrations little serious and consistent effort is being made by state and municipal police along this line. A systematic daily check on a certain number of licenses by each traffic patrolman, is absolutely essential to ensure that all drivers are licensed, and that illegally licensed and law-evading drivers are removed from the highways.

Besides requiring each motorist stopped to produce his driver's license, the traffic policeman should also make a habit of examining the car registration. Check on the registration aids in the detection of stolen cars and incorrect or unreported changes of address.

Apprehension of Drivers Violating Traffic Laws and Safe Driving Practices

The task of supervising the behavior of drivers on the streets and highways commonly falls to the lot of municipal and state traffic policemen. This function is carried out with widely varying degrees of effectiveness from jurisdiction to jurisdiction. The principal reasons for lax enforcement on the highways are (1) an inadequate number of patrolmen, (2) unsuitable use of the available patrolmen, (3) faulty training of traffic patrol forces, and (4) disregard of duty by the police.

Undoubtedly the most important reason for inadequate enforcement on the highways in most localities is an insufficient force of traffic policemen. The number of patrolmen available for traffic work is seldom adequate except in a few large cities. Many smaller cities and rural areas are badly in need of more road patrolmen.

The size of the state traffic patrol * is usually determined by the wealth of the state and a number of other factors other than relative need, whereas the size of a traffic force should be determined by such factors as the vehicle-miles traveled and the accidents incurred within the state. States whose highways have little traffic and few accidents do not need to support large patrols. On the other hand, states with heavy traffic and large numbers of accidents should have a similarly sized patrol.

It is estimated that there are in all approximately 7,000 state troopers patrolling the 845,326 miles of our main federal, state, and county highways. This is an average of one trooper for every 120 miles of highway, or one trooper for every 4,300 motor vehicles. [120, *65*]

With this inadequate number of patrolmen it is necessary that the state police authorities make the best possible use of every available trooper. Accidents do not occur evenly throughout a state but tend to "bunch" themselves at given locations; this occurs for a combination of reasons—such as traffic density, driver habits, weather, physical hazards, etc. An accepted principle among progressive highway police is that troopers must be available at those times when and those places where accidents are most frequent. In order to distribute patrolmen most effectively it is necessary for the police supervisor to have at his disposal complete information about the variations in accident groupings in different parts of the state, and during different times of the day, days of the week, and seasons of the year.

* All states now possess state police forces. In most states these agencies have as their chief function highway patrol, although a number of them also have criminal apprehension duties. Highway patrols vary in size from 10 men up to 1,500 men.

And not only do we need quantitative selective enforcement, but also qualitative enforcement as well. If, for example, the percentage of fatalities is high, an excess of reckless or drunken driving is a natural presumption, calling for rigid enforcement on violations of this type. If property damage is high, it may indicate some disturbing local physical hazards, either of a temporary or of a permanent nature, calling for a different kind of treatment.

Unfortunately such "selective enforcement," either quantitative or qualitative, is seldom carried out, principally because of a lack of easily available and well-organized facts about the type of accidents and when and where they occur.

Another cause of ineffective police activities is the lack of traffic police training. Since traffic law enforcement is entirely different from criminal law enforcement, the average policeman is not very well fitted to act as a traffic patrolman without special schooling.

Michigan, which has one of the oldest and most efficient traffic police forces in the country, requires all candidates for appointment to its state police to meet especially high standards as regards education, experience, character, and personality. [163, *44*] It also conducts a thorough six-week training school for state police recruits. New York, among cities, has similar requirements. Badly needed in city as well as in state police departments are more rigid regulations of this kind for the selection and training of traffic police personnel.

Trained traffic policemen are particularly successful in solving hit-and-run accident cases. Each hit-and-run accident requires a thorough study by a specially trained team of investigators. Although since most hit-run accidents occur under the cover of darkness, and witnesses are usually difficult to secure, by the application of a painstaking and detailed technique worked out by Northwestern University Traffic Institute, trained police can trace and apprehend nearly all drivers in hit-and-run accidents. [219, *155 ff.*]

Traffic patrolmen need support in their efforts at enforcement. When they find that many of the persons they apprehend are able to exert "pull" to have their tickets or summonses "fixed," they tend to refrain from issuing them except to a few flagrant violators. If the law is to be adequately enforced traffic patrolmen must not be subjected to political pressure. They must receive the honest backing of their superiors at all times. The public, too, must do its share by not demanding special privileges and by supporting police officials who carry out their duties without fear or favor. Only when the traffic laws are administered fairly and impartially can we expect to obtain the respect for them which safe

driving demands. For one doesn't mind stiff treatment if it is meted out equally to all who deserve it.

Constructive Supervision of the Drivers on the Road

Highway enforcement officers should in addition to administering the law try to eradicate the basic causes of accidents by endeavoring to improve the safety attitude and conduct of drivers using the highways. Their activities should be constructive and rational. They should impress upon the apprehended drivers the fact that driving involves a considerable element of responsibility to society, and that unsafe driving, being opposed to the best interests of society, cannot be tolerated. Without such an approach highway police will not be able to enlist the voluntary co-operation of motorists in operating their cars safely.

A commonly neglected function of the police is that of cautioning drivers and of pointing out to them the danger of their actions. Many traffic offenders do not willfully disobey the laws or knowingly ignore safe driving practices. They commit dangerous acts through ignorance or temporary inattention. There is much to be said for the policy of police departments which train their officers to deliver safety talks, rather than to arrest all drivers whom they stop. In many cases it is sufficient for the officer to point out the possibilities of damage from the driver's action without punishing him. Even if an arrest is necessary, an explanation of the danger involved in the violation is more effective than a mere description of the nature of the offense.

The difference between the old-fashioned "you're a villain" kind of police approach, and the new "you're a gentleman" type of address is well illustrated in the following quotation from Ralph L. Lee: [157]

Motorist's reply to officer who has just stopped him for running a traffic light:

Motorist: "Say, that light changed on me when I got too far across. If I'd'a stopped, I'd've blocked traffic."

Old fashioned policeman: "I've heard that same story from the last three guys that ran this light. I saw yuh. You were asleep at the switch. Suppose someone had been comin' the other way. Where do you think you'd'a been now? On the road to the hospital, that's where! If you don't give a damn for yourself, why don't you think of other people?" (writing ticket)

Modern salesman type policeman: "I don't know whether you know it or not, but there have been three bad wrecks and two fatalities on this corner during the last two months. Wish you could have seen the last one. It sure was a mess . . . the fellow that was hit . . . came through just like you did. They tell us down at headquarters that running through signal lights causes

most of our accidents, and we've had so much trouble at this corner that I have been keeping my eye on it. . . . I guess that's why I got you tonight. You see, accidents count against us . . . we want to keep them down . . . after all, that's our job. I tell you frankly, I don't get any kick out of handing people tickets, and I don't do it unless I have to. But going through lights is just too important for us to let anybody get by with it, so I guess the only thing I can do is give you a ticket." (writing ticket) "Say, I wish you'd tell your friends about this corner. It sure is a bad one."

Since the traffic policeman is in constant touch with the driving public it is desirable that he possess qualities of patience and courtesy. It is possible to impart instructions to the erring motorist so as to inspire the desire to follow them. But the average policeman needs training before he is capable of delivering an effective safety talk to a nervous motorist. The officer must recognize that it is not his uniform which makes the impression, but his personality—his looks, his tone of voice, his gestures, his knowledge of accidents, and his sincerity. In recognition of the importance of such matters Commissioner Olander of the Michigan State Police has prepared a little manual on "Police Courtesy" for his troopers. [221] Traffic enforcement would be much better received and much more effective if all traffic policemen had to read and follow the recommendations contained in this booklet.

Enforcement of Accident-Reporting Requirements

The incompleteness of our data on accidents handicaps us in all our efforts at understanding and evaluating the seriousness of the accident situation (see also Chapter VI). State motor vehicle departments (to whom accident reports are sent in most states) are dependent to a large extent for accident information on the traffic police who patrol the streets and highways. These can, if they are alert, keep informed about every accident which occurs on the highways under their jurisdiction. In addition to the accidents which they investigate before the participants have left the scene, traffic policemen can also obtain tips of other accidents from garages, filling stations, restaurants, and inhabitants of houses located on the streets and highways they watch. The complete cooperation of state and municipal police authorities in sending in reports of accidents is of prime importance in aiding the central state accident record agency in obtaining complete reporting of all accidents.

It is generally admitted that accident reports by trained investigators are more complete and truthful than the reports of the parties involved. Police reporting of accidents both rural and urban is therefore much to

be desired. To facilitate the investigation of accidents by trained personnel some states now require that an immediate report be made by telephone to the nearest police station of every serious accident. Further extension of this type of law is extremely desirable.

Surveillance of Violation and Accident Repeaters

Bad drivers can be improved, but it is necessary first to find out who they are. To do so, every state must maintain permanent records of all violations and accidents.

The basic defect in most state record systems is the lack of a complete up-to-date master record file. Such a file should contain full information about the driver concerned—all relevant personal data from his original and subsequent applications for a license, his driving examination scores, his experience, and dates and particulars of all his accidents, violations, complaints, and warnings. Such records should be filed alphabetically according to the name of the operator, and a system employed to flag or mark the cards of repeaters in order that they may be easily picked out from the files. Records should never be removed from the files unless the driver is reported dead, or has failed to renew his license for a considerable period of years. The number, date, and type of accidents and violations should be summarized on a folder or card, thus enabling the driving record of each operator to be seen at a glance. A number of state motor vehicle departments have recently started such master record files, but in only a few states, notably Connecticut, New Jersey, New York, and Rhode Island, have the files been going long enough for the departments to segregate the majority of their accident and violator repeaters.

Many states keep their accident, violation, and warning records separately and file them away by years. It is impossible under such a system to obtain the complete driving record of a motorist for more than a year without consulting several different files, the older ones often being stored in inaccessible basements. The lack of central, cumulative record files is one of the reasons why many state authorities in charge of drivers have been able to do so little to control accident-repeater drivers. Adequate record keeping is just as important in the control of drivers as it is in the control of criminals.

Accident and violation records should be easily accessible and used by traffic policemen. Police should be furnished with the names of accident and violation repeaters in the same way that they are furnished with identifying material about criminals.

Punishment of Traffic Offenders to Fit the Offense

A number of different types of punishment have been employed to discipline the erring driver. They include:

1. Warning tickets.
2. Arrests with fines.
3. Arrests with jail sentences.
4. Suspension or revocation of the driving license.
5. Suspension or revocation of the registration plates.

But no one type of punishment should be used to the exclusion of all others. The important thing is to employ that type of punishment which has the most constructive effect on the person involved, and which discourages negligent and careless driving behavior on the part of motorists in general.

A verbal warning, although it does have a temporary effect on some operators, does not impress the motorist nearly so much as a written warning. Warning tickets are effective in the case of minor violators, since a good many drivers are guilty of only an occasional lapse from grace, and are duly impressed when they are caught and given an official warning. But written warnings ordinarily have little or no effect on chronic violators or repeaters. Badly needed is a system of cumulative warnings, whereby, on the receipt of two or three warnings for moving violations within a twelve-month period, the license of the violator is suspended. Warning systems are seldom adequately administered by highway police today, largely on account of lack of sufficient clerical help to handle the records.

Arrests with fines are effective in the case of first offenders and persons with small incomes, but have little effect on chronic repeaters, on the wealthy, or the children of those in the high-income brackets. Fines are of little avail in the case of incompetent drivers whose greatest need is for education rather than punishment. Traffic fines are frequently collected primarily for revenue purposes. In many cities fines are assessed indiscriminately on the willfully negligent and on the well meaning; on repeaters and on first violators. Such a system has little effect on disciplining the drivers arrested, or in improving the subsequent road performance of the majority of drivers arrested.

Arrests with jail sentences undoubtedly carry the maximum punishment value as far as the respectable citizen is concerned. But jail sentences have less effect upon drivers with previous records of violations and accidents. For the chronic violator or accident repeater the most effectual punishment of all is to prohibit him from driving.

An important handicap in punishing traffic offenders is the backwardness of our traffic courts. Approximately four and one-half million persons appear before traffic courts each year. In many cities traffic cases constitute the majority of all legal cases. Yet traffic offenses are ordinarily tried in the same way as other criminal offenses. The late Professor Newman F. Baker of Northwestern University Law School put the matter aptly when he said:

> The field has grown so rapidly that it is no longer a small isolated segment of the criminal law but traffic cases occupy a large part of the time of the lower courts. It is indeed unfortunate that automobile "crimes" still must be tried by the ordinary courts of criminal law. Today, the proper enforcement of traffic laws is not so much a matter of criminal law enforcement as it is efficient and wise administration. [219, *65*]

A southern judge lets traffic violators roll dice to see what their sentences will be. This goes over big with some offenders who hope they will get a pair of ones instead of rolling sixes. In the mid-west a judge frequently leaves the bench during the examination of witnesses. He goes into his chambers while witnesses are testifying and comes back in time to decide the case. One Indiana judge decided 48 cases with an average of less than two minutes each.

The foregoing are a few random instances of present-day inadequacies in administering traffic case justice, uncovered by the National Committee on Traffic Law Enforcement. Compiled from personal investigation and conferences with police officials, court officials, motor vehicle administrators, and other officials in 44 states and 60 cities, and from questionnaires sent to attorneys general, to 1,500 traffic court judges and more than 12,000 justices of the peace, the Committee's report with recommendations should play an important part in stimulating traffic courts to adapt themselves to meet more adequately modern needs. [286] The Committee recommends that all courts should treat traffic cases apart from their other business. Among their proposals is "to utilize effective methods other than fines and sentences for the punishment and treatment of traffic violators." [286, *4*]

The tendency is growing in many states for the motor vehicle departments to aid the police in enforcing traffic regulations by using their suspension and revocation authority more frequently. The majority of states which license drivers grant to the licensing department the authority to take away licenses. The Uniform Vehicle Code, which has been adopted by a number of states, provides that:

> The department is hereby authorized to suspend the license of an operator or chauffeur without preliminary hearing upon showing by its records or other sufficient evidence that the licensee:

1. Has committed an offense for which mandatory revocation of license is required upon conviction;
2. Has been involved as a driver in any accident resulting in the death or personal injury of another or serious property damage;
3. Is an habitually reckless or negligent driver of a motor vehicle;
4. Is an habitual violator of the traffic laws;
5. Is incompetent to drive a motor vehicle;
6. Has permitted an unlawful or fraudulent use of such;
7. Has committed an offense in another state which if committed in this state would be grounds for suspension or revocation. [190, *9*]

Many states unfortunately have not seen fit to adopt this entire section of the Uniform Code. An important reason for this is that state administrators, remaining in office only two or three years, have insufficient time to gain the full confidence of the public. The public's lack of confidence in the administrator inevitably results in his authority being limited and the full power of the Vehicle Code not being granted him. The advantages of the strong centralized power granted by the Code are thus forfeited.

Where such broad authority is available a state administrator has at hand the means properly to punish bad driving. It should be pointed out, however, that many state administrators with such broad powers of suspension seldom use them freely. In fact, so few licenses are taken away in most states that the average driver is led to believe that his license is a permanent authority to drive.

We need a much more extensive use of the authority to suspend or revoke licenses and registrations along the lines adopted by Registrar Goodwin of Massachusetts, if we are ever to inculcate in drivers a proper respect for the driving privilege. Commissioner MacDonald of the U. S. Public Roads Administration emphasizes this point forcefully when he says:

> The recognition of the responsibility resting upon the individual driver for accident prevention so far outweighs any other consideration that a sound action program must include as the most effective weapon of society in attacking the problem of accident prevention, the generally exercised power to revoke drivers' licenses for infraction of the traffic laws. [164, *34*]

In general, the loss of the driving privilege is more effective than warnings, fines, or jail sentences; it usually has maximum disciplinary effect on the bad driver. License suspension and registration plate confiscation together are about the most drastic and pointed punishment that it appears possible for society to invoke on the violator of traffic laws.

The vast number and complexity of motor vehicle accidents calls for a simplification of the procedure of treating offenders and for delegating

more discretionary authority to the motor vehicle administrator. The administrator is a specialist and spends all his time regulating drivers. He is therefore much better fitted than either legislators or judges to decide when set suspensions should be given and how long they should be.

The Reward of Good Drivers

Although educators have long recognized that rewards, when skillfully assigned, are just as effective as punishment in controlling human activity, practically nothing has been done by public officials to encourage good driving by rewarding those motorists who go for long periods without accidents.

Commercial fleets, on the other hand, have used rewards and found them of aid in reducing accidents. The most effective reward has been found to be an emblem which increases the prestige of the good driver among his fellows, rather than a monetary bonus.

Since the control of the commercial fleet operator over his drivers is quite different from that exercised by a community or state over its operators, we should not expect methods which apply in one case always to work out equally well in the other. A small community might, for example, like a fleet, obtain excellent results by awarding emblems or prizes to its safest drivers, because of the prestige that would accompany the winning of an award in a closely knit group. But the award of safe driver emblems in a large city would be of little consequence since prestige among strangers is little sought after.

Stoeckel, May, and Kirby have suggested that the state reward careful drivers. [268, *263*] They recommend that the states issue merit markers to those drivers who have had perfect driving records for at least two (or perhaps three) consecutive years, that is, who during this period have not been involved in accidents or committed violations. As they point out, the success of such a plan depends largely upon the care and impartiality used in issuing these markers. Although they do not tell us just what the marker should consist of, they imply that it might be a special form of license plate. Connecticut issues initial license plates which are supposed to be granted only to those who have accident-free records of five years' duration. The Connecticut system is very popular among the relatively small number of motorists who have been lucky enough to apply in time to secure the initials they desire. The drawback is that there are not enough initial plates to go around among all the drivers who can qualify for them.

The chief objection that has been raised to the use of merit markers on a vehicle is that there is no way of distinguishing non-owner-drivers.

This objection could easily be met by requiring each driver to carry a colored license certificate in a transparent holder in the windshield of the motor vehicle he is driving, the ordinary license being one color and the merit license, another. The possible benefits to be derived from some such system of rewarding the good driver would seem to justify giving one a try.

Another scheme of rewarding the good driver is that used by stock insurance companies. These companies return a bonus of 15 per cent of the original premium to all operators who go without accidents during the year in which the insurance is in force. The insurance carriers report that this type of reward has the effect of encouraging their policyholders to drive more safely.

The art of rewarding motorists who drive well is worthy of study. The strong arm of enforcement may seem much simpler and more effective, but we may discover one of these days if we try, as animal trainers found years ago, that as good or better results are obtained by using a lump of sugar than by wielding the lash.

The Re-Education of Drivers

After educating pedestrians, requiring periodic inspection of vehicles, modernizing roads, stiffening the license examination, providing driver-training courses, enforcing the traffic laws, punishing erring drivers and rewarding good ones, we still have left one of the most important problems of all, namely, that of improving the driving habits of the motorists on the road.

Of the numerous suggestions which have been offered for re-educating licensed drivers, three in particular merit attention. They are (1) periodic re-examination of drivers, (2) schools for traffic violators, and (3) driver clinics.

Periodic Re-Examination of Drivers. There are several reasons why we need a periodic re-examination of all drivers:

1. To check on drivers who have never been examined.
2. To assist aging drivers to detect defects so that they can compensate for them.
3. To keep drivers up to date on changes in traffic regulations.
4. To enhance the motorist's respect for his driving privilege.

Since the majority of drivers have never taken license examinations (their licenses having been renewed from licenses originally granted before examinations were given) it is desirable to examine those motorists who have been granted renewal licenses as a matter of course, to see

whether they have proper driving habits, normal vision, and a knowledge of traffic regulations and good driving practices. California, which has instituted a system of periodic re-examination of drivers, reports that examiners find more things wrong with experienced drivers who have never been examined than with beginners. Moreover, the general reaction of experienced drivers who have taken such an examination is favor-

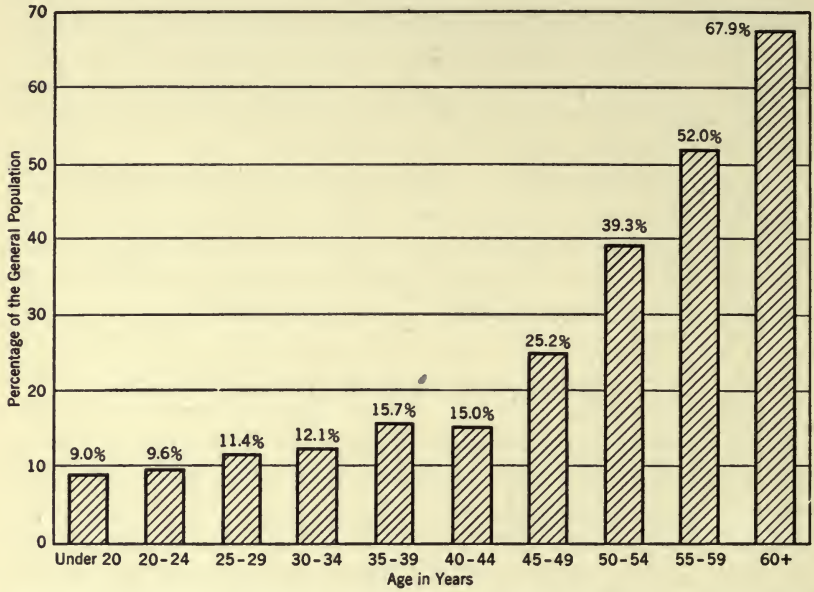


FIG. 51. Prevalence of defective vision at different ages (20/50 or less in one or both eyes).

Source: S. D. Collins and R. H. Britten, "Variation in Eyesight at Different Ages, as Determined by the Snellen Test," *Public Health Reports*, 39, 3191 (1924).

able. Most of them report that the examination helped them by showing them some of their shortcomings.

The proportion of persons having eye defects goes up markedly after the age of 45 as shown by Figure 51. In addition there is a slowing down of reaction time and loss of coordination with advancing age. Some elderly persons recognize these signs of oncoming age and compensate for them by reducing their driving speeds, and by venturing out after dark only when absolutely necessary. But many motorists who do not compensate for the aging process need to be re-examined and be shown this decline in ability.

Progress in transportation is accompanied by changes in motor vehicle and traffic regulations. The average driver seldom keeps himself in-

formed about them. A periodic re-examination of traffic laws and regulations based on the material in an up-to-date driver manual would help to keep him abreast of the latest developments in motor vehicle laws and safe driving practices.

But most important of all, periodic re-examination of drivers serves as a constant reminder that driving a car is a privilege, which, to be retained, requires not only a good driving record but also a constant improvement in knowledge and driving skill. It enhances the safety value of the driver's license by requiring study and improvement on the part of those who keep it.

Schools for Traffic Violators. Among the drivers most prone to future accidents are those who have incurred one or more violations. A special study of the personal injury accidents incurred by a group of non-violator drivers as compared with those incurred by groups of violation-repeater drivers in Wichita, Kansas, showed that the drivers with no violations had fewer accidents than the violators (see Table 59, Chapter IX).

At present most cities which do anything at all about traffic violators are inclined to assess fines on the majority and to commit to jail a few of the most flagrant cases. But recently a more constructive method of handling traffic violators has been introduced in a number of cities. It involves sending the violators to school.

What Is a Traffic Violators' School? A number of cities now operate schools for traffic violators. Among them: Detroit, Michigan; Louisville, Kentucky; Evanston, Illinois; and Los Angeles, San Diego, Berkeley, and Long Beach, California. The training in such schools commonly consists of a course of four to six evening sessions of one or two hours' duration, conducted by police officials and other specially qualified persons. Courses are ordinarily limited to 30 persons so that discussion can be encouraged.

Violators are sent to the traffic violators' school from the juvenile court and the various justice courts. Reckless driving, excessive speeding, driving without a license, violation of pedestrian rights-of-way and violation of stop signs are typical offenses for which a driver is sent to school.

Classes consist of illustrated lectures conducted in an informal manner such as to encourage student participation. Blackboard illustrations and miniature streets with model cars on tables are used to clarify discussions of specific types of accidents. A safety film serves as a good introduction to break down too formal schoolroom atmosphere and to emphasize the constructive purpose of the course. Two or three outlines of such courses are available. [3, 46, 210]

It cannot be emphasized too strongly that the success of a traffic school depends upon the caliber of the instructor. The latter must present informative material in such a way as to provoke discussion. At the same time to ensure attentive listening he must give a written examination at the completion of the course. The state motor vehicle department driver manual should be a required reading.

What Does a Traffic Violators' School Accomplish? The best answer to the above question is given in a report by O. W. Wilson, former Chief of Police, of Wichita, Kansas, who said:

> As measured by the percentage who do not repeat within a given time, the warning is less effective in nearly every instance than the arrest, and the traffic school treatment is markedly more effective in every case than the arrest. [292, *18*]

A traffic violators' school not only supplies bad drivers with information they need about driving at low cost, but it improves their subsequent road behavior. The missing element in the traffic school, however, is the lack of a constructive attempt to get at the cause of the individual driver's trouble. The reason many drivers have accidents is that they do not know enough about themselves to overcome or compensate for their individual shortcomings.

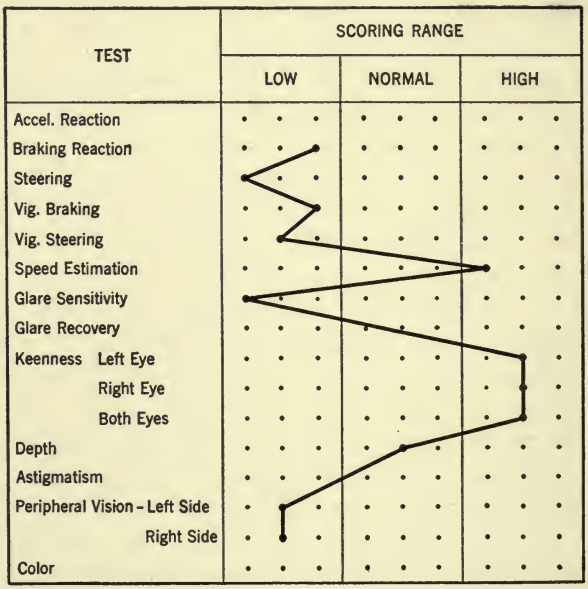


Fig. 52. Driving profile chart for "Boston El" bus driver scores on clinic driving tests.

DIAGNOSIS

His deficient peripheral vision which delayed his vision of things approaching from the side contributed to a number of accidents (1, 3, 7, 9, 17, 25, 26 and 28). His poor steering coordination contributed to glancing collisions in close quarters which a more skillful driver might have avoided (11, 14, 18, 20, 22, 27). A general attitude of carelessness is indicated by his failure to note faulty condition of his brakes (2), speeding (12), failure to look in both directions at an intersection (16), skidding (15, 5), allowing himself to be backed into (10). His slow reaction time, especially under complex conditions, increased his stopping distances and contributed to collisions (16, 17, 22), which might otherwise have been avoided. His glare blindness predisposes him to twilight and night accidents.

Accident History

Entered bus service 1929. Total 28 accidents: 13 exonerations, 1 suspension, 7 reprimands, 3 instructions.

1. 1929 Girl running left to right in front of bus fell or was hit. Reprimanded.
2. 1929 Low air pressure on the brake. Bus dodged a car which had stopped in front, and hit a post on the left. Reprimanded.
3. 1929 Sideswipe with a vehicle going in the same direction on the left. Reprimanded.
4. 1929 Sideswiped a parked car. Instructed.
5. 1930 Bus skidded into the rear of taxi. Instructed.
6. 1930 Brushed tire of bus against edge of platform.
7. 1930 Sideswiped a car parked on the right. Reprimanded.
8. 1930 Right angle collision from the left after the bus had stopped. Exonerated.
9. 1930 Bus was cut in front of from left to right. Bus hit this car and pushed it into the car in front. Reprimanded.
10. 1930 Backed into at stop light by parked car. Exonerated.
11. 1931 A car waiting for the bus to pass was run into and pushed into the left side of the bus. Exonerated.
12. 1931 Right angle from the right. The bus was speeding. Suspended two days.
13. 1931 Bus hit in the rear while stopping short. Exonerated.
14. 1932 Right angle collision from the right in the right rear. Exonerated.
15. 1932 Skidded into hydrant starting up.
16. 1932 Bus ran into in the rear while stopping to avoid a truck which was crashing the light. Exonerated.
17. 1932 Dog ran in front of the bus from the left and was killed.
18. 1933 Sideswiped a car parked on the right while pulling into a bus stop. Instructed.
19. 1933 Boy went out the window to evade fare, and the rear wheel ran over his foot. Exonerated.
20. 1933 Sideswiped with a vehicle going same direction on the right rear, while rounding the Harvard Square kiosk. Reprimanded.
21. 1934 Car backed out of driveway on left across street into standing bus. Exonerated.
22. 1934 Bus pulling to right to avoid truck, hit car standing on the right. Reprimanded.
23. 1934 Skidded into from behind. Exonerated.
24. 1935 Sideswipe with vehicle going in the opposite direction. Exonerated.
25. 1936 Bus making a right turn, involved in a collision from the left. Exonerated.
26. 1937 In turning left the bus sideswiped a vehicle going in the same direction on its right rear. Exonerated.
27. 1937 Bus pulled away from a boy who jumped off the rear of a truck going in the opposite direction, and the bus hit a truck parked on its right. Instructed.
28. 1937 Sideswipe with vehicle going same direction on the right rear of the bus entering the Sumner Tunnel. Exonerated.

Driver Clinics. This need has been met in another method of treating violator drivers—the driver clinic. [78, 79, 297] A half dozen states and cities (including the Pennsylvania Motor Police, the California Motor Vehicle Department, The Wichita Police Department, the Milwaukee

Safety Commission, the Detroit Police Department, the Chicago Municipal Court, and the Chicago Park Commission) and a number of commercial concerns now subject repeater violators and drivers who have incurred accidents to such a clinic (see Figure 52).

What Is a Driver Clinic? A driver clinic program consists of an objective diagnosis of driving skill through the use of scientific apparatus (such as was described in Chapter IV), supplemented by a road examination and an interview aimed at getting the driver to talk about his driving history.

The possible defects of skill that may contribute to the accidents of drivers are numerous and poorly understood by the driving public. An unskillful driver needs someone to examine him, to make a diagnosis and tell him how to go about improving his driving. This the driver clinic attempts to do.

In a driver clinic the motorist is first subjected to a number of different tests, including those for braking reaction, steering, speed estimation, depth vision, peripheral vision, visual keenness, and glare and night vision.

The use of a battery of objective tests serves two purposes: (1) it furnishes objective information about how the individual compares in sensory capacity, motor skill, and reaction time with other drivers; and (2) it greatly increases the subject's confidence in the supervisor's diagnosis and advice.

The laboratory tests are followed by a road examination, after which the supervisor, who is usually an experienced psychologist, draws up the examinee's profile chart, accident and violation history, and makes a clinical analysis of what is wrong with his subject's driving. He explains the ratings on the various tests and makes an effort to encourage each applicant to analyze his limitations with a view of eliminating them or else of figuring out ways to compensate for them. For example, he may tell him that he needs to have his eyes examined, or that on account of his inability to see normally at night he should drive as little as possible after dark. Since no two operators have the same defects, and every driver's problem is different, treatment must be adapted to fit the individual case if the goal of personal enlightenment and improvement is to be attained.

Each subject who goes through the clinic is treated courteously. Elderly persons are handled with considerable deference, while cocksure youngsters may have to be treated more firmly.

What Do Driver Clinics Accomplish? As an example of the beneficial effects of a drivers' clinic the results of a study made by the California Department of Motor Vehicles may be cited. In this study 97 habitual traffic violators were tested and their scores analyzed. The figure below

compares the accident records of this group of violators with that of a control group of 97 equally violation-prone drivers who were not tested in the clinic. In the two years preceding the tests the drivers who were summoned to the clinic had had 7 per cent more convictions for major violations than the untested drivers, whereas during the two years following the tests, the drivers who were examined had 70.6 per cent fewer

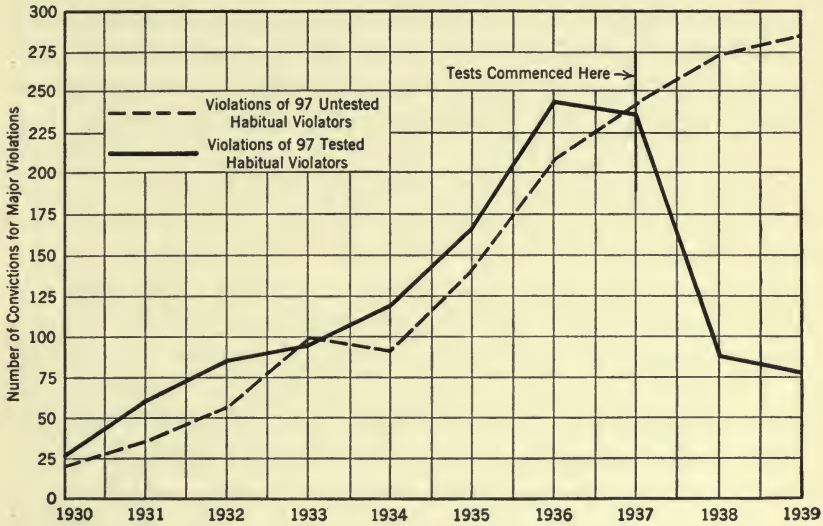


FIG. 53. Improvement in violation records after attending clinic.
Source: E. D. Fletcher, *Preliminary Report on Special Tests*, Part II, p. 17 (mimeo). Department of Motor Vehicles, Sacramento, Calif.

convictions for major violations than those who were not. The California Department of Motor Vehicles concludes that:

> The evidence establishes beyond a doubt that the special tests had a marked effect on habitual violators, and that these tests were a valuable medium through which improvement in driving attitude was effected. [105, *18*]

A driver clinic is, therefore, an effective method for individually reeducating drivers whose records of violations or accidents show that they need constructive advice.

WINNING PUBLIC SUPPORT FOR IMPROVED DRIVER CONTROL METHODS

Effective driver control in a democratic country like the United States always involves a compromise between the interest of the individual with regard to his convenience in using his vehicle, and the interests of the

group in conserving life and preventing jury. In other words, although driving must be made safe, the individual's freedom to drive must not be too severely restricted.

Our highway safety progress depends on intimate intercommunication between safety officials and the public, for until the American public gives the safety authorities the green "go ahead" signal, these officials cannot enforce the laws effectively. And until the authorities are able to put across to the public via our communications systems a convincing factual plea, the public will never be ready to push the "go ahead" button. Also, without proper communication the authorities would be unable to distinguish clearly when the public has turned on the green light. Paths of communication must therefore be kept clear between public officials and drivers. This necessitates the hearty cooperation of the press and the radio with public safety officials to enable them to keep in close touch with the public.

Safety propaganda must stress not only individual self-discipline but also the social necessity for enforcing obedience by official authority. Safety propaganda in the past has devoted itself almost exclusively to trying to coax or wheedle the motorist to drive more carefully. But, besides stressing personal responsibility, safety propaganda must gain public approval to enact appropriate driver license and traffic laws, to secure money for their execution, and to enforce them without fear or favor. Public officials engaged in accident prevention activities are badly in need of public indorsement. Most state safety agencies, being of recent origin, have not had so much time to build up support for themselves either with the executive and law-making bodies, or with the public at large, as have older departments. Consequently much of the highway safety propaganda has had to be carried on by private or city organizations. Extension of this work by state agencies seems logical and desirable.*

Faults of Present-Day Safety Propaganda

One of the first steps in a successful program to reduce automobile accidents is to interest the public in the accident problem and in means of solving it. It must be admitted that the American public has never let itself become greatly concerned about highway accidents, despite all that has been said and written about them in the past few years. The principal reasons why safety propaganda has not been more successful are its lack of continuity and its poor quality.

* See "A Guidebook for Traffic Safety Education" for suggestions as to how states can promote safety education through the radio, newspapers, speakers, etc. [8]

Let us first take up the question of continuity, the absence of which is a serious cause for criticism. The typical safety campaign either attempts to arouse public concern by gruesome stories or pictures calculated to frighten motorists and pedestrians into using the highways more carefully, or else appeals to "sportsmanship" with an emphasis on cheery slogans. Such campaigns, which usually last for only a few days or weeks, have been shown to reduce accidents for short periods, but with the passage of time the emotional impression wears off, the newspapers turn their attention to other features, and automobile accidents creep up again.

A second reason why current safety propaganda is so ineffectual is its quality. In this regard the most common criticisms of safety propaganda are that:

1. It is too tedious and stereotyped.
2. It is too general.
3. It is not adapted to fit local conditions.
4. It is naive.
5. It is not prepared by men with an adequate knowledge of the problem.

Present-day propaganda is dull. It is inclined to moralize too much and to make too frequent use of negative admonitions. If it employed more humanly interesting facts about drivers and the causes of accidents, it would stand a better chance of convincing the public of the importance of its message.

The average city newspaper, for example, although it may publish advice in driving given out by various sources, relegates news of accidents to curt notices in inconspicuous places in the middle of the paper. The technique employed by other safety-minded newspapers of publishing interesting front-page accounts of automobile accidents occurring locally with illustrative diagrams and analyses of causes brings accidents much closer home to the reader.

Since people have a tendency to look at problems from the standpoint of how they themselves are affected, they should be shown how bad driving practices and attitudes may cause them losses as individuals, or result in losses to their community or state. We must convince the motorist that as a general rule his interests will best be served by what serves the best interests of the group. Special studies must be made and their results publicized to show the loss to the individual in particular communities and states from automobile accidents, and similar surveys showing how much saving in dollars and cents could be expected from expenditures on the right kind of accident prevention activities. The average citizen will cooperate better in promoting safety if he can see in advance just what return he can expect from the expenditure of definite public funds. In

addition to working on the public's emotions, we need also to work on its money sense. We need to reduce safety talk to simple economics.

Pedestrians require a different approach. For the pedestrian, physical injury is the paramount consideration, since that is the practically unavoidable result of his collision with a motor vehicle. Pedestrian propaganda should emphasize the self-protection motive. The pedestrian must be made to recognize his unprotected position while crossing or walking along highways, and to realize that between him and injury from an approaching car lies only the fallible judgment of another human being.

The very quickness with which we remove all traces of automobile collisions from the highways tends to prevent the public from being reminded of the consequences of accidents. It has been suggested that we leave the remains of more collisions along highways, or at least indicate by appropriate signs by the roadside the dangerous locations where accidents have occurred. Other means may be devised to make safety education more vivid and specific.

The effectiveness of safety propaganda is usually directly in proportion to its applicability to the local situation. If safety campaigns were directed less at the populace at large and more at those areas and population groups with high accident rates, safety workers would accomplish more. In accident prevention, states and communities, like individuals, are aided most by information which is directly applicable to their special problems. We need selective educational safety propaganda adapted to fit the problems of specific groups.

Propaganda gains its ends in proportion not only to its relevance but also to its manner of approach. At present we are woefully ignorant about the relative usefulness of different types and methods of appeal. For example, a study should be made of the emotive significance and of the meanings of all the words commonly used in connection with the highway safety problem. Such a study would be most valuable to guide writers on safety in the choice of the proper language in which to couch their appeals to the public. Certainly an experimental study of the meaningfulness to the public of safety words and slogans would be well worth while.

All too often the person who writes highway safety propaganda knows little about the facts, or else has insufficient ability to put his message across in popular language. An important reason why much safety propaganda is so superficial and ineffective, is that the persons who write it are unprepared and ill-provided to do their jobs properly.

The greatest difficulty in putting forth convincing highway safety material stems from the lack of fact-gathering and planning agencies to supply needed information on which to base effective propaganda. If some provision is eventually made for a national research and planning

agency with coordinated state agencies (such as is discussed in Chapter XVI), sufficient accurate and interesting data about the causes and means of preventing highway accidents would become available for publicity purposes.

To improve the continuity and quality of safety propaganda it would be desirable for every state to have an accident prevention publicity director provided with an adequate secretarial staff, to devote his entire time to informing the public, and the legislative, judicial, and executive branches of the state government about the status of the state highway accident situation, and to support with facts and figures all worthy plans proposed for its solution.

ACCIDENT PREVENTION THE END OF DRIVER CONTROL

As has been indicated in the foregoing discussion, driver control involves a number of different types of activities. At present in most states these activities are carried out in independent departments: licensing, suspension, and accident collecting, by the motor vehicle department; supervision of the driver on the road and enforcement of traffic rules and regulations, by state and municipal police departments; individual education of the driver-to-be, by the schools; and group education of the adult motorists, by safety councils, chambers of commerce, service organizations, and a variety of other agencies.

Although it is undoubtedly easier to secure cooperation and coordination by placing most of the driver control functions under one head as has been done in a few states,* integration of activities can also be achieved either through voluntary personal cooperation of the department heads involved, or through their representation on a central committee similar in composition to the ones recently set up to coordinate defense traffic activities (see Chapter XVI). The tendency of separate state departments has been to carry out their nominal fee collection and enforcement activities and to neglect accident prevention activities, especially those of a constructive nature.

A broader viewpoint of accident prevention through license control is much to be desired among state driver control agencies. The main purpose of driver control is the reduction of accidents, to which end the driving license must be made a privilege and the license holder shown that he will be permitted to drive only so long as he demonstrates by his behavior on the road judged in the light of his driving history that he is deserving.

* In California, Virginia, and a few other states the motor vehicle and highway patrol functions have been combined under one department.

CHAPTER XV

HIGHWAY SAFETY PLANNING

HOW WELL HAVE WE DONE IN REDUCING ACCIDENTS?

Although some progress in national highway accident reduction can be noted, consistent improvement is yet to be achieved (see Table 39). We are still killing over 30,000 persons every year with automobiles, injuring more than a million people and causing many millions of dollars' loss in property damage. The lack of progress in reducing highway accidents is seen not only in the country as a whole, but also in different regions, in states within these regions, and in individual cities. Improvement has been anything but uniform throughout the United States (see Table 53). Certain states have made marked advances by the effective use of approved safety techniques, some have stood still, and others have gone backwards. The accident records of cities have shown similar inconsistencies.

WHY ACCIDENT REDUCTION HAS NOT PROGRESSED MORE RAPIDLY?

The lack of sustained, uniform progress in accident reduction has resulted in part from a lack of appreciation of the seriousness of the highway accident problem and in part from ineffective, unscientific methods of attack. The two problems of overcoming indifference and of discovering the most effective methods of reducing accidents under a particular set of conditions are intimately connected. A successful attack on the accident problem depends on an authoritative plan which has proved its effectiveness in reducing accidents, just as much as it does on the acquisition of funds and public support. Unquestionably, one of the important reasons why public agencies in charge of highway safety activities have not been granted more adequate funds is that both their programs and their accomplishments have lacked conviction.

An appreciation of the need for adequate planning of highway safety activities has recently been indicated by the appearance of a number of suggested national, state and city plans, and programs outlining recommended activities.

PROGRAMS FOR THE REDUCTION OF HIGHWAY ACCIDENTS

The programs advanced for the amelioration of the traffic accident problem fall into three categories: (1) national, (2) state, and (3) community.

A National Program for the Reduction of Highway Accidents

As yet no complete national highway safety program has been formulated although a number of suggestions to include in such a plan are available. One of the best sketches of a national program is contained in an article by Thomas H. MacDonald entitled "An Action Program to Advance Safety on the Highways." [164] *

According to Commissioner MacDonald the following eight points provide a sound foundation for road traffic control and regulation on a national basis:

1. Uniform state motor vehicle traffic laws.
2. Skilled investigation of traffic accidents.
3. The establishment of a uniform system of accident reporting.
4. The establishment of adequate highway patrol and official inspection of vehicles.
5. The establishment of complete and final authority over the issuance and revocation of drivers' licenses.
6. A highway improvement program divided into two general classes of projects: (*a*) those of the emergency type; and (*b*) those for the long-time plan.
7. A plan of state and federal safety organization adequate to secure on a wide scale the adoption and enforcement of the action program proposed.
8. A national safety education program.

These points raised by Commissioner MacDonald are worth discussing in some detail.

Uniform State Motor Vehicle Traffic Laws. When the first laws to control cars and drivers were established by the legislatures of the different states these regulations naturally varied widely. To bring some order out of the chaos of conflicting laws which then existed, Secretary of Commerce Herbert Hoover, at the request of a group of motor vehicle administrators, in 1924 organized a National Conference on Street and Highway Safety. Meeting several times over a period of years this organization compiled a Uniform Vehicle Code.

* In addition to this plan a number of other treatises offering suggestions along this line are available [194, 238, 268] as well as a program for states [124], the last of which will be taken up in some detail later in this chapter.

This Uniform Vehicle Code comprises a set of recommended law codes for states, covering the registration of vehicles, the licensing and examining of drivers, and the regulation of traffic on the highways. [189, 190, 191, 192, 193]

The Uniform Vehicle Code has played an important role in guiding the passage of uniform legislation for the control of drivers and for standardizing traffic regulations. A detailed study made by the U. S. Public Roads Administration of the divergence of state laws from the Uniform Code indicates, however, that substantial improvement in the laws covering the control of drivers and motor vehicles is needed in the majority of states. [232] Particularly needed is a re-codification of traffic laws in the various states, simplifying and standardizing them to conform to the Uniform Vehicle Code.

Skilled Investigation of Traffic Accidents. Understanding of the fundamental causes of highway accidents depends in the final analysis on scientific investigation of individual accidents. An important reason for the remarkable accident record of commercial aviation is the excellent work of the Civil Aeronautics Administration in investigating each accident incurred by transport planes. Scientific investigation of automobile accidents would similarly provide valuable information upon which more intelligent prevention programs could be based. As long as our information is founded on the reports of interested operators, accurate information as to the real causes of accidents will remain difficult to discern.

A step in the direction of obtaining worth-while accident reports would be to train all rural highway patrolmen to investigate accidents thoroughly in accordance with the best modern techniques, and to establish specially trained accident investigation squads in urban areas (see Chapter VI). The cost of such a program would be small in comparison with the benefits to be derived.

The Establishment of a Uniform System of Accident Reporting. To further the establishment of uniform accident reporting a Conference on Uniform Traffic Accident Statistics has recently been organized, composed of representatives of various public and private organizations concerned with highway accidents. Among other proposed activities are the formulation of a standard accident report form, a standard state accident summary sheet, and standard definitions of the different kinds of accidents.

The use of uniform methods of reporting and analyzing accident data, permitting more reliable comparisons of the accident experience of different states than are now possible, would be of considerable value to individual states. A periodic appraisal of its accident prevention program by each state and city requires comparisons of its records with those of other states and cities. Thus if two states have the same number of fatali-

ties but one has twice as many non-collision fatalities, the latter needs to analyze those non-collision fatalities to see if it does not need to attempt to curb high speeds, one of the primary causes of non-collision fatalities. Accurate comparisons, particularly of non-fatal accidents, can be made only if states and cities adopt and enforce a uniform system of accident reporting.

In view of the high cost of accidents, and the sizeable sums spent for street and highway improvements, traffic control equipment, police departments and courts, and driver licensing, examining, and training in those states where such activities are carried on, it is unquestionably a good investment to spend a moderate amount in collecting accident information to find out how the various accident prevention programs are working out, which ones need to be expanded, and which may properly be restricted.

The Establishment of Adequate Highway Patrol and Official Inspection of Vehicles. Lax enforcement of traffic laws is one of the weakest links in our traffic control program. Contributing to this situation are three factors: (1) inadequate numbers of traffic policemen to patrol the mileages over which there is appreciable traffic, (2) diversion of traffic policemen to non-traffic activities, and (3) outmoded methods of traffic law enforcement.

The solution to the first problem involves convincing state legislatures and municipal authorities of the vital part that an efficient traffic police force plays in accident reduction. The second problem is, in part, an administrative one and exists chiefly because many police administrators underestimate the importance of traffic work in comparison with criminal work. Regarding the third problem, a common error of many police administrators is to underemphasize the educational aspects of traffic law enforcement. Too drastic enforcement may arouse public antagonism and eventually bring about a general relaxation of effort. On the other hand, a reasonable, impartial program of enforcement, accompanied by public education and studies to determine the effect of the program on accident rates, usually results in adequate public support. In the latter type of program the emphasis of police enforcement is on accident reduction and not merely on technical violations of the law.

As was pointed out in Chapter XI, periodic inspection of motor vehicles helps to keep mechanically defective vehicles off the road. For states wishing to improve the standard of their present system of inspection, or to adopt periodic inspection of vehicles, there is available a *Motor Vehicle Inspection Manual* approved by the American Association of Motor Vehicle Administrators. [10]

The Establishment of Complete and Final Authority Over the Issuance and Revocation of Drivers' Licenses. Undoubtedly the most effective means of disciplining the driver is the suspension or revocation of his license to drive (see Chapter XIV). Many officials in charge of motor vehicle bureaus make inadequate use of this device. Two possible reasons why this method of driver control is not employed more often are that (1) many motor vehicle administrators do not possess undisputed authority to suspend licenses, and (2) there is insufficient understanding of the importance of segregating and disciplining the small group of accident-prone drivers who incur a much higher than normal proportion of accidents.

The adoption by all states of Section 30, Article III, Act II of the Uniform Vehicle Code giving state officials discretionary authority to suspend and revoke licenses, should solve the first problem; and the multiplication of evidence about the seriousness of the violation- and accident-repeater driver along the lines outlined in Chapter IX should help to prove to administrators the need to deal with such motorists more effectively than has been customary in the past.

A Highway Improvement Program Divided into Two General Classes of Projects: (1) Those of the Emergency Type, and (2) Those for the Long-Time Plan. The factual basis for a national highway program is already being provided in the material which is being assembled by the State-wide Highway Planning Surveys in the 48 states. Emergency projects involve the elimination of those conditions on highways which have been found to contribute most to accidents. Other emergency activities include: the relocation of signs to fit changing highway conditions, such as increase in speed of travel; the correction of sight distances, particularly at intersecting roads; and the widening and maintenance of shoulders.

Long-range improvements involve the adoption of standards for new construction which will embody all the significant features which have proved to be of value in the reduction of accidents. Among these are the provision of medial strips on multiple-lane highways, the elimination of cross traffic wherever feasible, and the installation of grade separations. In the past year or so the program outlined in Chapter XII for the development of a coordinated system of interregional highways has become an integral part of our long-term national highway improvement program.

A Plan of State and Federal Safety Organization Adequate to Secure on a Wide Scale the Adoption and Enforcement of the Action Program Proposed. Commissioner MacDonald's lengthy service in the federal government and his intimate contact with the develop-

ment of the highway safety movement from its earliest beginnings make his suggestions along this line of particular importance. He says:

> Just how the federal government fits into the general scheme of an adequate traffic safety organization is not clear beyond debate, but there are considerations of public policy which prompt the suggestion that no wholly new board, commission or other Federal authority is desirable. To be effective, such a Federal organization would have to duplicate organization, authority and operations now lodged in some federal department. There is need for a correlation of the federal activities and relationships between the federal departments themselves, and between the federal government and the States in both the official and public aspects.
>
> A plan of federal organization that can be made effective at once and make use of the going operations of the government, would be the establishment of an inter-departmental committee with representatives assigned from all of the federal organizations which now have authority over, and responsibility for, elements of the safety problem under the federal laws. In addition to this official organization there should be an advisory committee composed of representatives of the important national associations which are engaged in the traffic safety field in its broad aspects. This plan together with the plan of organization of the state safety authority would form a complete national structure for the formulation of an adequate nation-wide program and its effective operation. [164, *37*]

Some national guidance of traffic safety activities plus a contribution of the federal government to research in this field is sorely needed. Further elaboration of this idea with Commissioner MacDonald's more recent suggestions will be found in the concluding chapter of this book.

A National Safety Education Program. Any successful national safety program must be educational in the sense that it must persuade administrative officials to enforce its proposals, legislators to enact supporting laws, engineers to build more safety into streets and highways and the vehicles that use them, and most important of all the public to support its efforts.

In directly educational efforts, general provision should be made to educate pedestrians and future drivers in safety classes in the elementary schools and supplemented by driving training in the high schools. Adult programs of driver training and education in safety must also be publicly sponsored. These would include schools for traffic violators and periodic re-examination of all licensed drivers (see Chapter XIII).

Large truck, bus, and taxicab companies, which have been able to reduce accidents and lower costs by a safety program of careful selection and training of drivers, of close supervision, including the use of discipline and rewards, and of proper maintenance of their vehicles, should

have their best practices summarized and made available for the use of all concerns employing drivers.

Advanced courses of a more technical character for traffic engineers, traffic police supervisors, driver license supervisors, and teachers of safety need to be provided. In addition police and motor vehicle departments should conduct training and refresher courses for traffic patrolmen and license examiners.

A State Program for the Reduction of Highway Accidents

The Automotive Safety Foundation (an agency for expending funds contributed for safety work by commercial groups connected with the manufacture of automobiles) has formulated a "Standard Highway Safety Program for States" as depicted in the chart. This skeleton program outlines seven aspects of state safety activities. Engineering, enforcement, and education represent the functions of the highway, police, and education departments. To these three E's has been added a fourth activity—motor vehicle administration, which, although it overshadows the three E's in importance, is often omitted in safety programs. Uniform safety legislation by state legislatures is listed as a fifth item. The sixth and seventh items, personnel training and research, refer not to any particular departmentalized activities, but rather to improvements in the personnel and administration of all departments.

Engineering, Enforcement, Education, and Legislation. As has been pointed out in our discussion of MacDonald's program there is an urgent need for improved state *highway engineering*, for more extensive and rigid *enforcement*, for a comprehensive *educational* program, and for uniform *legislation*. As for the importance of supporting these state activities, there can be little argument. The chief criticism of past efforts in these fields has been the tendency to continue to operate along traditional lines. There has been far too much smugness, and far too little scrutiny of the appropriateness of methods employed. Much to be desired is an objective study to ascertain the relative general importance of different safety activities. Such a study might profitably have as its goal the determination of the advantages and limitations of the various types of accident prevention mentioned above, and the definition of the circumstances and occasions under which each can be employed to best advantage.

Personnel Training. The field of personnel training is fortunate in having been selected for special attention in recent years by the Automotive Safety Foundation and the National Conservation Bureau (an agency supported by the stock insurance companies to foster safety promotion and safety education).

The Northwestern University Traffic Institute, financed in large part by the Automotive Safety Foundation (fellowships are also provided by Alfred P. Sloan, Jr., and by the Kemper Foundation), has performed a commendable public service in providing training to selected city and state traffic policemen from all over the country. As a consequence of this stimulation many states and cities now operate their own courses for recruits and "graduate" courses for experienced traffic policemen.

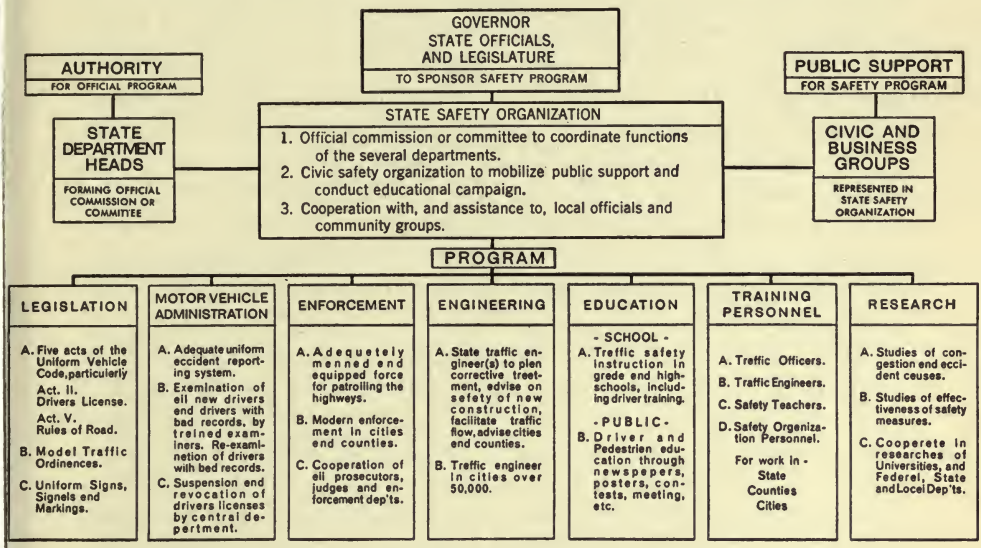


FIG. 54. Highway safety program for states.

Source: Automotive Safety Foundation, Washington, D. C.

Departments of other institutions of higher learning such as the University of California, under the leadership of O. Winfield Wilson, and Rutgers University, where the work is under the guidance of Lawrence B. Tipton, have also contributed to this field.

The Yale Bureau for Street Traffic Research offered a similar course of training for traffic engineers under a grant from the Automotive Safety Foundation (with fellowships from Alfred P. Sloan, Jr.). The influence of the 100 or more men graduated from this one-year course is gradually exerting itself in improving traffic engineering, particularly in cities.

A large number of colleges and universities are now offering special summer courses for safety instructors. Pennsylvania State College's Institute of Safety and New York University's Center for Safety Education, supported by the National Conservation Bureau, are pioneers in this field.

Considerable scientific investigation is needed to bring the lecture material and textbooks used in training traffic engineers, enforcement offi-

cials, and safety educators up to the academic standards existing in the related fields of engineering and government. (Traffic engineering in the university set-up fits in under highway engineering, which should include this subject.) To parallel the facilities for training in these fields there should be similarly good facilities for educating motor vehicle department personnel.

Motor Vehicle Administration. Another vitally significant but hitherto underemphasized safety activity is control of the driver by means of the license—a function the full exercise of which involves not only what we know as motor vehicle administration, but enforcement and education as well. Although driver license laws are in the statutes of all but three states, in only a few states has the motor vehicle administrator been able to make full and effective use of his authority over the driver.

There are a number of reasons for this. Two important ones are that (1) the administrators themselves, being subject to political control, seldom stay in office long enough to carry out long-range programs, and (2) the authority to control the driver is divided among several state departments with a resultant loss in effectiveness.

The importance of *selecting competent administrators and then of leaving them in control* cannot be overemphasized, for even the most brilliantly conceived driver license law will be a failure in the hands of poor administrators, whereas a competent administrator can often secure surprisingly good results from a poorly designed and weak law.

The problem of providing adequate tenure for administrative officials in charge of drivers is a difficult one because it runs counter to our American custom of rewarding party followers by appointing them to important state administrative positions. Naturally the office of motor vehicle commissioner, with one of the largest staffs of employees in the state, is eagerly sought after by political supporters. But until state executives adopt the practice of choosing motor vehicle administrators with regard for their professional qualifications for the office and of leaving them in office as long as they carry out their duties satisfactorily * we cannot expect governmental management of the driver to be as constructive and as successful as we have a right to expect. It is of prime importance also that the legal term of the motor vehicle administrator be sufficiently long for him to become experienced in his work.

When the problem of regulating motor vehicles and drivers began to develop, the various needed regulatory activities were delegated to those old-established state departments whose activities they most closely re-

* By giving the deputy administrator a permanent tenure of office some states thereby ensure a certain degree of continuity of policy in spite of frequent changes of the appointive head of the department.

sembled. Thus even today the agency in charge of licensing drivers and registering vehicles is under the revenue department in many states for the sole reason that it collects revenue from fees, regardless of the fact that its primary function is one of driver control and accident prevention. Similarly, the task of apprehending violators and enforcing the traffic laws has been originally delegated to state police departments, because driver regulation originally seemed to resemble criminal law enforcement. Traffic safety education is not adequately cared for in most states for the reason that nobody knows quite where it belongs in the state administrative set-up or which department should pay for it.

The state department which issues and revokes drivers' licenses is naturally in the key position to administer accident prevention activities. But instead of coordinating all phases of the state regulation of drivers having to do with licensing, examining, and educating drivers, and enforcing laws, around one agency, most states have distributed the various phases of driver control among several separate departments. Driver licensing and examining and vehicle registration are usually placed together under what is commonly called the motor vehicle department. The apprehension of traffic violators and the enforcement of traffic and motor vehicle laws on the highway, which are equally basic to driver control, are commonly vested in the state police department.

Accident reporting and recording is allotted to the motor vehicle department, to the state police department or to the highway department, instead of being correlated with all three. In only a few states are accident records centralized and properly used for the valuable purposes of segregating and controlling incompetent drivers, guiding the disposition of the traffic police, and indicating to the highway department the hazardous stretches of road which need to be improved.

The education of the driver, where it is dealt with at all, is usually divided among the motor vehicle department, a few interested public schools, and various private safety organizations. State education departments seldom officially support driver instruction and training. And only in rare cases are the standards of school safety training coordinated with the standards of driver examining, even though training and qualifying drivers are closely interrelated.

Undoubtedly, one of the most serious drawbacks to effective driver safety efforts is that the various means of regulating drivers are not centrally coordinated. Driver regulation cannot be dealt with as efficiently or as economically by a variety of state organizations as by one—for driver management, although it has many phases, is basically one problem. In the few states where it has been directed by a strong unified state organization, instead of by several smaller and more or less independent organi-

zations as is common in many states, it has been much more effectively handled.

Why Certain States Have Been So Successful in Reducing Accidents. In spite of handicaps of various sorts, consistent progress in accident reduction has been achieved in a number of states. The reasons why are not hard to discern. Let us survey in alphabetical order five of these states with outstanding records (see Chapter VIII) and point out some of the reasons why they have been so successful in reducing accidents.

Connecticut, one of the states outstanding in highway safety promotion, has had only three motor vehicle commissioners in the last twenty-five years. The first, Robbins B. Stoeckel, one of the most progressive motor vehicle administrators in the country, remained in office for seventeen years, and the second, Colonel Michael A. Connor, recently stepped out after eight years of splendid service. An outstanding feature of the Connecticut department is its efficient system of accident reporting, recording, and analysis under the direction of William M. Greene. More than any other state, Connecticut has for a number of years been getting the facts about accidents and using them in driver management, driver education and enforcement, and in highway engineering. Connecticut has also had a State Traffic Commission composed of its motor vehicle commissioner, police commissioner, and highway commissioner, to coordinate the activities of their respective departments.

The Commonwealth of Massachusetts has long been a leader in highway safety. Much of its enviable record can be attributed to its present motor vehicle administrator, Frank A. Goodwin, whose tenure of office has extended over a total period of fifteen years. During this time he has built up in the motorists of Massachusetts a most profound respect for their licenses by his consistent policy of suspending and revoking licenses of violators on the basis of complaints of traffic patrolmen. In this way he saves the motorist unnecessary court expenses, and permits the patrolmen to spend a much larger part of their time on the road. The confidence and respect which the majority of Massachusetts citizens have for Registrar Goodwin, together with the Commonwealth's outstanding safety record, is the best proof that anyone could offer that efficient driver regulation requires a strong administrator who wields his suspension and revocation authority without fear or favor.

The state of New Jersey has acquired a name for itself by the remarkable progress it has made in recent years in reducing accidents. Since it began licensing drivers in 1906 it has had only five motor vehicle administrators. Commissioner Arthur Magee, the present incumbent, has been in office for six years. Previously, he served for several years as deputy commissioner. The New Jersey motor vehicle department has an

unusually experienced and efficient staff of men with authority and training not only to examine and license drivers, but also to enforce the motor vehicle laws and promote educational activities. The availability of well-trained men to examine license applicants, patrol the highways, pick up suspended licenses and revoked plates, and plan and carry out educational programs enables this strong, centralized department to control and improve drivers much more efficiently than is possible in states where these functions are dealt with by separate staffs of men in independent departments. Another outstanding feature of the New Jersey department is its system of semi-annual inspection of vehicles which is the model for state-operated inspection stations throughout the United States.

It is fortunate for our national record that New York with over three and a half million licensed drivers and the biggest driver management problem of any state ranks with the leaders in consistent accident reduction. New York has been lucky in retaining the services of two unusually capable administrators over the last sixteen years. Commissioner Carroll E. Mealey in particular has been a leader in the introduction of new ideas and in emphasizing a broad, well-rounded program of accident reduction. New York was one of the first states to institute annual training schools for its license examiners. It has an exceptionally fine accident record and research department under the supervision of Robert J. Maloy. The annual reports of the New York department are models of excellence.

Rhode Island stands first in its present fatality rate per vehicle-mile, and in the consistency of its improvement over the last fifteen years. Like other leading states it has wisely chosen competent administrators and left them in office for long periods. Registrar George Wellington served twenty-seven years, and Wilfred Paquin, the present incumbent, has acted in this capacity for eight years. Its small area together with the fact that Providence newspapers, which for years have stressed safety, cover the state thoroughly, simplify the problem of arousing public sentiment for safety education and for the strict enforcement of motor vehicle and traffic regulations. The compactness of the state also facilitates cooperation between motor vehicle, police, and educational authorities. But if the average Rhode Islander were asked to indicate what he regarded as the most important single factor contributing to his state's splendid record he would most likely point to the strict enforcement of speed limits both on main rural highways as well as on city streets. Fixing of tickets has been eliminated and speeding drivers are summarily punished. With lower driving speeds deaths from automobile-automobile collisions have almost disappeared (in 1940 they amounted to only 4 per cent). Rhode Island's most pressing problem as regards fatalities remains to teach pe-

destrians to cross roads cautiously since two-thirds of its deaths involve persons on foot.

Other states in the northeastern part of the country have similar outstanding features or a combination of features in their motor vehicle departments which have enabled them to continue to reduce their fatalities year after year. More recently a few states in other parts of the country have set up strong, centralized departments and have made considerable progress. The northeastern states, therefore, will have to look to their laurels if they hope to continue to lead either in present standing or in consistent progress.

Research. The most important and unfortunately the most neglected phase of highway accident prevention is research. Highway accidents result from a multiplicity of causes which vary according to locality, circumstances, and types of drivers. To focus preventive activities on the principal causes of accidents in a certain state or community research on these particular causes is necessary.

Another need for research is to discover the cheapest and most effective methods for systematically reducing accidents. At the present time there is an overemphasis on some safety activities which although relatively expensive are ineffectual, and a neglect of other safety activities which are both inexpensive and highly effective.

A third need for research is to assist in reaching and influencing the public mind. Cars and roads can be improved without consulting the public, merely by the decision of a handful of executives or public officials to adopt a new design. For this the approval of the car-riding public does not have to be obtained. But in a democracy a program of driver education and control has to be "sold" to those affected, as well as to those with authority to adopt it, before it can have much effect. Hence public administrators in charge of motor vehicles are particularly in need of objective studies of the facts which underlie their problems by the best available scientific talent. Armed with such information they can much more effectively urge the passage of appropriate laws, fight the enactment of "crackpot" legislation, and gain the backing of the public for a strict but intelligent administration of their delegated authority.

Hundreds of thousands of dollars have been expended to sustain safety propaganda and to train traffic engineering and enforcement personnel. On the other hand, basic research on what are the causes of accidents, what can be done to meet them, and how to make an intelligent and factual (rather than emotional) safety appeal to the public, has attracted little attention.

A Community Program for the Reduction of Highway Accidents

Cities and towns, on account of their relatively small areas and dense populations, can put into operation certain safety measures much more effectively than can states. Such things as the training of drivers in public schools, the re-education of drivers within accident-prone areas, and the use of newspaper and local radio programs to interest the public in the accident problem are activities that can best be undertaken by cities and towns.

Traffic Accident Prevention Planning for Communities. A number of community safety programs have been proposed by different organizations including the National Conservation Bureau, the National Safety Council and the Metropolitan Life Insurance Company. [179, 195, 209]

Typical of such volunteer organizations is the Citizens Traffic Safety Committee whose functions are taken up on the following page.

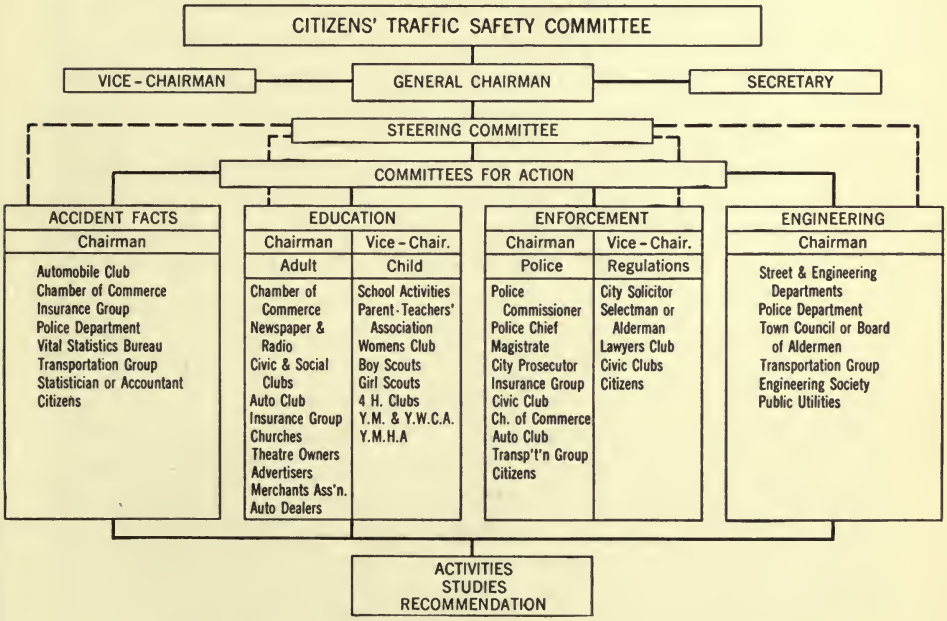


Fig. 55. Organizational chart of Citizens Traffic Safety Committee.

Source: *Creating Safer Communities*, opposite p. 24. National Conservation Bureau, New York.

A pamphlet accompanying this chart outlines recommended types of activities for the various committees:

Accident Facts Committee:

1. Aid police department in setting up recommended accident-reporting procedures.
2. Collaborate with police department in analyzing accident records.

Education Committee:

1. Promote safety education in the elementary schools.
2. Establish courses of instruction in good driving in the high schools.
3. Promote adult education in traffic hazards and secure the cooperation of drivers and pedestrians in the local program.

Enforcement Committee:

1. Adopt the uniform traffic regulations and municipal ordinances recommended by the National Conference on Street and Highway Safety.
2. Establish a traffic court, or arrange to have the existing court devote a part of its time exclusively to traffic violations.
3. Establish an Accident Prevention Bureau within the Police Department.
4. Assist police to conduct a selective law-enforcement program to achieve maximum results at minimum cost.
5. Work toward the abolition of ticket-fixing.

Engineering Committee:

1. Standardize signs, signals, street markings and traffic control devices, using those recommended by the National Conference on Street and Highway Safety, or the same as modified by state authorities.
2. Improve the efficiency of traffic flow by rerouting through-traffic, by improving street design and by making special restrictions governing the direction of vehicular traffic.
3. Make a study of the worst group of accident locations and eliminate the hazards by proper means.

The four committees must, of course, work together as a unit, not exaggerating the importance of their respective tasks nor minimizing the importance of the activities of the other committees.

Why Certain Communities Have Achieved Marked Success in Reducing Accidents. Community safety succeeds only when it concerns all citizens. In every instance of community success in dealing with the traffic accident problem active public support has been enlisted. The passage of model laws and rigid enforcement are of little avail unless public-spirited citizens cooperate in promoting the traffic safety program.

Examples of Providence, Rhode Island; and Waukegan, Illinois. Providence, Rhode Island, with a rate of 7 fatalities per 100,000 population as compared with a rate of 14 fatalities per 100,000 population for all cities, generally admitted to be the safest city of its size in the United States, affords an example of what can be done through a well-integrated program of traffic safety.

According to Ralph Eaton, Providence's traffic engineer, the "will of the people" has been the most important factor in bringing about the low accident rate for which the city is noted. [90] The people of Providence have fallen in solidly behind the safety program as developed by the city authorities and are proud of their good record. This community pride in turn has heightened each individual driver's sense of responsibility.

Providence's safety program has many different features. The city has an unusually capable traffic engineer, a strictly enforced 25-miles-an-hour speed law, and a driver-training program. It has stopped ticket fixing and seen to it that the police department enforces traffic regulations. It has interested its newspapers in headlining accidents and featuring deathless days, but above all, as we have just stated, it has interested the people who live in Providence in accident reduction and made them look upon safe automobile driving as an important community achievement.

The story of what Waukegan, Illinois, has done is an example of what a number of smaller cities are doing to control their drivers and reduce accidents.

In 1935 Waukegan formed a community safety council composed of six men from the six service clubs in the city. Under their leadership traffic ordinances were revised and enforced, ticket fixing was abolished, driver training was introduced in the high schools, and public support was enlisted to aid the police department in curbing bad driving.

The resulting improvement in traffic safety in Waukegan is shown in the table below.

TABLE 76

IMPROVEMENT IN TRAFFIC SAFETY FOLLOWING ADOPTION OF SAFETY PROGRAM IN 1935

(Waukegan, Illinois, 1935–1938)

Classification	1935	1936	1937	1938
Accidents	652	417	370	298
Motorists injured	106	93	80	84
Pedestrians injured	54	54	37	23
Deaths	7	5	5	1

Source: *Safety Education, Eighteenth Yearbook*, p. 344. American Association of School Administrators, Washington, D. C., 1940.

The hardest thing about a community safety program is to get it started. One solution to this problem is for the state to assume responsibility for initiating safety committees in all those cities and towns wherein they

are needed. Some state departments already sponsor safety committees in municipalities. In addition, they supply cities with accident data, safety speakers, driver education, and traffic engineering advice, etc.

A much better program would be for the state to allocate funds to municipalities for accident prevention purposes on a fifty-fifty basis. This method which has been successfully employed by certain states in raising the efficiency of community schools, ought to prove equally as effective in reducing accidents in urban areas.

A NEEDED FEDERAL-STATE HIGHWAY SAFETY PLANNING PROGRAM

The three types of programs which have just been outlined—nation, state, and community—are not independent of each other, but, on the contrary, are closely related. Many of the measures which are found to be important in one are equally important in the others. This relationship is particularly strong in the case of state and national programs, since national progress in the reduction of accidents is largely dependent on the adoption by states of recommended safety measures. In the absence of a federal agency directly concerned with the reduction of traffic accidents it has devolved on the individual states to devise their own accident prevention programs and to undertake such measures as have seemed appropriate.

The various highway safety plans that have been suggested have resulted in considerably less action than might have been expected. One reason is that highway traffic conditions vary widely throughout the United States (see Chapter VIII). As a consequence, standard programs, although too advanced for some jurisdictions, offer little that is new to others.

Before individual states can put into effect the recommendations of the standard plans they have to adapt them to local conditions. Since the various functions of highway accident prevention are carried out by a number of separate departments, in most states this is a difficult problem. No one agency is available in the majority of states to take a broad view of the state highway safety problem, an attitude essential to successful planning.

The need for an agency in each state which can coordinate the various related activities and prepare a comprehensive highway safety program is made more necessary by the progress being made in traffic safety techniques. New methods are constantly being discovered and old methods improved. Continuity of planning is essential if these developments are to be made a part of individual state programs. Each state and com-

munity must analyze the new developments to determine their applicability to their own localities.

And, finally, it is essential that individual communities and states should fit their activities into a broad, flexible, national accident prevention program.

State and community highway safety planning could do all these things, but considerable reorganization and expansion of existing facilities and the initiation of systematic research on the highway accident problem in each state would be necessary to attain the desired ends. The formation of traffic accident research and planning agencies in each state, guided and assisted by a permanent national highway accident prevention agency, offers the best solution to the problem. The following chapter will develop this idea and will offer suggestions as to appropriate goals toward which such a coordinated federal and state program should work.

CHAPTER XVI

A PROPOSED HIGHWAY ACCIDENT PREVENTION RESEARCH PROGRAM

INDUSTRIAL SAFETY LEADS HIGHWAY SAFETY

Thirty or forty years ago the accident situation in industry and rail transportation was similar to that which exists on the highway today. Accidents at that time were a common occurrence, accepted as inevitable. However, with the development of more efficient methods of selecting, training, and, particularly, controlling the worker, accidents in these fields have been reduced to a small fraction of their former number. Modern industry and railroading are amazingly safe. Why? Because management has studied the human causes of accidents and effected changes in both men and their machines so as to eliminate or counterbalance these causes. What is particularly interesting in the progress of safety in manufacturing is the fact that as the causes of accidents were removed, production was not slowed down. Nor was the speed of railroad transportation decreased by an increase of safety. In many cases accidents were shown to be reliable evidence of correctible human or mechanical conditions which interfered with efficient production or operation.

Private management has discovered ways of eliminating accidents by educating and controlling the worker and by improving his tools. Governmental management in the same way needs to develop effective means of regulating the automobile driver and his vehicle to curb accidents. Present methods of training and examining drivers and of controlling both drivers and motor vehicles are far from adequate in most states (see Chapters XI, XIII, XIV).

RESEARCH ON ACCIDENTS LAGGING BEHIND ENGINEERING RESEARCH ON THE MOTOR VEHICLE AND THE HIGHWAY

Although more research is to be desired as a foundation for improving all phases of automotive transportation, accident prevention has unquestionably received the least attention.

Engineering research on the automobile has shown consistent progress for thirty-five years or more. An important clearing house for informa-

tion on different phases of automotive engineering research is the Society of Automotive Engineers, an old and honorable organization, founded in 1905, which has played a major role in bringing together the research engineers of the automobile industry. The *S. A. E. Journal* and the *S. A. E. Transactions* contain a mass of valuable research data on the motor vehicle.

In addition, each automobile manufacturer possesses a research laboratory and staff to work out problems in connection with the design of new models, as well as a proving ground where it is possible to gather engineering data about vehicles after they are built. From 2 to 10 per cent of each corporation's income is devoted to research, for no manufacturer could long remain in business without such a department to help it keep its product abreast of the general progress in the field.

As has been pointed out in Chapter XI, from a safety standpoint, there seems to be a need for continuing to improve the design of the motor vehicle, but by and large the automobile manufacturers have done an excellent job of providing vehicles which, in spite of their increasingly higher top speeds, can be driven safely. With the splendid research facilities at their disposal automotive designers will unquestionably continue to make progress in improving the safety features of the car. The chief contribution of the vehicle to accidents, however, seems to stem from neglect of the owner to maintain it properly. Primarily this is a problem involving the education and regulation of the owner by the proper state authorities. The responsibility of keeping the vehicle in safe operating condition must be delegated to the state and to the individual owner.

Engineering research on the highway has likewise shown marked progress. The Highway Research Board, a division of the National Research Council working in close cooperation with the U. S. Public Roads Administration, acts as a national clearing house for highway research activities and information. In its practical workings the functions of the Board have been to provide a forum for the discussion and publication of the results obtained by individual research workers, to organize committees of experts to plan and suggest research work and to study and correlate results, to publish and disseminate pertinent information, to provide a research information service, and to carry on special fact-finding investigations when funds are available. The membership consists of representatives of 28 associations, including technical and commercial groups and other organizations of national scope interested in highway construction and maintenance. The results of highway research carried out by private individuals, and by workers in universities and federal, state, and city highway departments, the Board publishes in its *Proceedings of the Highway Research Board.*

In addition to the Highway Research Board, the American Association of State Highway Officials, the American Road Builders Association, the Portland Cement Association, and the National Highway Users Conference (an organization sponsored by the Automobile Manufacturers Association which interests itself chiefly in legislation affecting motor vehicle taxation and regulation) have aided markedly the progress of highway transportation. The greatest contributions toward giving the United States its highway system, the finest in the world, however, have been made by the U. S. Public Roads Administration. Ever since 1916 the Bureau of Public Roads, or as it is now called, the U. S. Public Roads Administration, has carried on an unceasing campaign for better state highways and the continuous development of an improved and integrated national highway system. The recently initiated State Highway Planning Surveys (see Chapter XII) represent an important forward step toward completing and coordinating our vast mileage of highways by providing the basic facts upon which we may improve our roads to meet the needs of increasing traffic at a minimum of expense.

Compared with this flourishing engineering research on the highway, and with that on the motor vehicle, *research on accident prevention* has lagged far behind.

The most extensive study yet made of the highway accident problem was conducted at the recommendation of Congress by the Public Roads Administration in 1937. [231] A number of the findings of this investigation have already been referred to in Chapters II, IV, VI, and IX. This study showed clearly the gravity and complexity of our accident problem and how little we have done to solve it.

Individual state motor vehicle departments occasionally carry out research projects on accident prevention. The non-productiveness of these activities is to be attributed to the lack of funds in most departments for pursuing a consistent research program, and to the absence of means for exchanging research findings in order that one department can profit by the findings of another. In spite of these drawbacks some studies of considerable merit have been completed by state departments.

The two professional organizations which bring together administrative officials in charge of state driver and vehicle regulation are the American Association of Motor Vehicle Administrators and the International Association of Chiefs of Police. These organizations, in contrast to the automotive and highway organizations mentioned above, have been able to do little or nothing in the way of systematic research and planning until comparatively recently.

In 1938, with the assistance of a grant from the Standard Oil Company of New Jersey, the Association of Motor Vehicle Administrators set up an

Advisory Research Committee and initiated an active scientific highway accident research program in cooperation with the Yale University Institute of Human Relations. This cooperative research program continued under the name of the Yale Driver Research Center, by providing some of the answers to basic problems of accident prevention, is bringing light to the neglected highway safety problem.

With donations from the Automotive Safety Foundation, the Kemper Foundation, and Alfred P. Sloan, Jr., the International Association of Chiefs of Police initiated in 1936 a program of traffic police training at Northwestern University. This cooperative training program which has developed into the Northwestern Traffic Institute, is each year training a new group of young policemen from city and state departments in modern methods of traffic enforcement. During the last five years Lieutenant Kreml and his staff have assisted 25 cities and 2 states in reorganizing their traffic enforcement activities.

A number of private organizations have also contributed to the solution of problems relating to governmental accident prevention. Foremost is the National Safety Council. Although primarily concerned with industrial safety, the National Safety Council, Inc., a private organization supported by membership dues, sale of safety posters and literature, and fees for special services, through its annual publication *Accident Facts*, its periodicals, and the published findings of its committees on night traffic hazards, pedestrian control and protection, speed regulation, winter driving hazards, tests for intoxication and bicycle problems, has furnished considerable practical information of value to state and city officials concerned with highway safety problems. From funds provided by the Automotive Safety Foundation the National Safety Council has also been able to send field men into various states to work for the passage of desirable safety legislation, and to assist in organizing short courses for driver license examiners.

Mention should be made here of the National Conservation Bureau and the American Automobile Association. The publications and promotional activities of these organizations have aided in advancing highway safety throughout the United States.

NEED OF COORDINATION AND OF PUBLIC SUPPORT OF HIGHWAY ACCIDENT PREVENTION ACTIVITIES

Highway safety suffers from sins of both omission and commission. In many sections of our country nothing whatsoever is done about the accident problem. In others where safety measures are undertaken, the work is seldom administered efficiently. An important reason for this is that

highway safety is usually left either to public agencies whose energies are generally focused on activities unrelated to safety, or to poorly supported, relatively ineffectual private safety agencies.

Few state agencies concerned with motor vehicle regulation are free to devote themselves primarily to highway accident prevention. The majority have as their basic function the collection of license fees or the enforcement of laws. With them safety advancement is a distinctly secondary activity. These public agencies are not given adequate funds for preventive safety activities, nor are they free from the influence of pressure groups seeking political favors, which tends to undermine strict enforcement of the all-important license suspension authority.

Non-publicly supported agencies unfortunately have to spend much of their time soliciting memberships or pledges, selling safety information, or striving to gain public recognition for their sponsors or themselves.* And since industrial safety yields larger returns to private safety organizations than does highway safety, those private safety organizations which have a stake in the promotion of industrial safety naturally devote the major share of their energies to the field from which their principal income is derived.†

There is little coordination of activities among public or private agencies. Duplication of effort and cut-throat competition are not uncommon. Activities are undertaken without proper planning, and studies are rarely made of their accomplishments to discover whether the program was justified and the money wisely spent.

The highest commendations are, of course, due a few safety organizations which have made notable advances in spite of hardships and an unpromising situation. But it must be admitted that highway accident prevention activities can never be successful throughout the United States until wholehearted public support is accorded our understaffed and neglected state driver control agencies. Highway accident prevention is a public responsibility. It should not have to depend upon private enterprise or on privately supported or volunteer organizations.

* Safety agencies sponsored by car manufacturers and finance companies and by automobile insurance companies have unquestionably contributed to highway accident prevention, but the value of their work would be enhanced many times and would be accepted much more readily by the public and public officials, if their sponsors would insist that more emphasis be put on safety research and less on ballyhoo and thinly veiled advertising.

† Private safety agencies make few if any contributions to research. The dependence of successful highway accident prevention on systematic research and on the widest possible dissemination of such information as is available, regardless of the users' ability to pay, argues strongly for making it a regular governmental function.

Ultimately highway safety should and undoubtedly will be included like other types of conservational work as a regular function of our federal, state, and municipal governments, for the solution to most of the difficulties previously mentioned lies in extending and strengthening governmental management already operating in the field of highway safety. And as is pointed out later in this chapter, leadership in bringing about improved functioning of state accident prevention lies primarily with our federal authorities in cooperation with organizations of state officials.

NEED FOR SYSTEMATIC RESEARCH AND PLANNING

The field of highway administration was similarly handicapped by confusion of purposes and lack of coordination a few years ago. Progress in the development of highways, especially of those highways outside of the Federal-Aid system, varied widely. An important reason was that many state highway departments possessed very few facts about the status of their highways and the traffic they carried; without this essential information it was impossible for them to allocate their available funds effectively. It was to fill the need for such facts and carry out the necessary research that the U. S. Public Roads Administration instituted the State Highway Planning Surveys in 1936.

The organization of the Planning Surveys was not an easy task. Five years were necessary before all the states could be induced to set up these fact finding and planning agencies. Some public administrators and legislators were slow to recognize the value of research as a basis for efficient planning even though the federal government offered to make funds available to support such activities. The Surveys today, however, have demonstrated their worth and are rapidly being incorporated into the framework of existing state highway departments.

An organization patterned after that administering the State Highway Planning Surveys is needed to deal with the problem of accident prevention.* The development of a program of systematic research and planning offers manifold possibilities for the conservation of life and the prevention of waste of our material resources.

In connection with his research for the American Association of Motor Vehicle Administrators the author has come in touch with the majority of state safety officials throughout the country. Association with these lead-

* Although Highway Planning Surveys have done a little work on safety (see Chapter XII) they have so many other urgent activities that it is questionable whether they will ever be able to tackle the accident prevention problem. And if they ever do concentrate on safety they will undoubtedly confine themselves to the highway engineering phase of the subject.

ers confirms the author's impression that intensive and systematic research on highway accident prevention problems on a nation-wide scale is of the greatest interest to them. Motor vehicle administrators throughout the country have eagerly accepted the research findings so far obtained by the driver research sponsored by them at Yale, and have, wherever possible, put into operation the recommendations of the Association of Motor Vehicle Administrators based upon these findings. This ready acceptance of research reports and recommendations bears evidence of the need for a continuance and expansion of such research and advisory activities.

In view of this interest in research on the part of public officials why, may we ask, has so little been done in developing a systematic highway accident research program? The answer may be summed up in one phrase: lack of money. The dearth of funds to conduct research work has seriously hampered the effectiveness of all national, state, and municipal agencies concerned with traffic safety.

FINANCING RESEARCH AND PLANNING ACTIVITIES

One of the first problems to be solved in setting up governmental highway accident prevention research and planning on a systematic basis is to work out a satisfactory method of financing such activities. Research and planning agencies cannot be expected to work efficiently if they have to spend a large share of their available time, as is the case today, in soliciting support and funds for their continuance. Accident prevention research workers should be freed from policies, politics, and peddling their product.

In view of the tremendous stake that our nation as a whole has in conserving life and property on the highways, and of its lack of success in coping with the problem so far, it is time for the federal government to assume some obligation in financing a prevention program.

The federal government could reasonably be expected to finance entirely that part of our accident prevention research and planning which has to do with the nation as a whole, and to contribute on a fifty-fifty basis to the establishment of separate research agencies in each state. Such a federal contribution to states which would aid in inducing them to initiate the necessary research programs, would also ensure their cooperation with federal authorities in aligning their individual programs to fit in with a master plan for the entire nation.

Automobile manufacturing, petroleum, and insurance interests, in view of the loss to their own businesses from the killing and disabling of customers in accidents, as well as from the reduction in the use of motor

vehicles as a consequence of increasingly jeopardous travel conditions, would profit if accidents were drastically reduced and driving made safer. It would, therefore, be to their advantage and to the public interest if these agencies were to add their influence and, at least during the formative years, their financial support to a scientific fact-finding program so essential to solving the highway accident problem.

Many commercial concerns having a stake in highway safety, like those mentioned above, have spent considerable sums of money adjuring the public to drive and walk safely. The American people frequently yield to the blandishments of advertisements to buy Superbo Automobiles, Speedo Gasoline, and Protecto Insurance, but they are not so easily coaxed into driving and walking cautiously. American advertisers are without peers in selling products, but proof is still lacking that they can sell safety as a sideline to a commercial appeal. Such proportion of their funds as automobile, petroleum, and insurance companies feel could justifiably be devoted to keeping their customers alive and out of the hospital would yield far greater returns if spent on finding out something about the accident problem than on boring the public with hackneyed admonitions about safety.

PROPOSED NATIONAL AND STATE RESEARCH AND PLANNING AGENCIES

As far back as 1924 a start was made toward coordinating, systematizing, and making more uniform the state regulations relating to the control of the driver and vehicle, with the formation of the National Conference on Street and Highway Safety (see Chapter XV). But although this National Conference has accomplished a great deal in promulgating the Uniform Vehicle Code which comprises a set of model state and municipal regulations for the control of traffic on the highways, as an organization it has a number of shortcomings. Carrying out its work by means of committees of volunteers living in various parts of the country and meeting infrequently, it has been unable to undertake the continuous, systematic research and fact gathering so necessary for effective planning and accomplishment.* Having only a loose association with federal and state authorities in charge of motor vehicles and drivers and no funds to aid states and municipalities in carrying out its proposals, it has been able to do little to secure acceptance of its recommendations.

* That the National Conference recognized this lack is indicated by the numerous resolutions it has passed recommending that research on accident prevention be carried out in cooperation with public officials.

As a consequence the National Conference on Street and Highway Safety has not achieved nearly so much as its founders had hoped it might.

Badly needed in highway safety is a strong, active national-state organization patterned after that operating the Highway Planning Surveys. Such an organization should include a central coordinating agency with associated agencies in each state.

The Structure of the Proposed Agencies

Since most of the actual work of managing drivers and vehicles is carried out by states, the cornerstones of the program should be individual state research and planning agencies. Such agencies would serve to ensure adequate attention being given to problems peculiar to the different states.

The agencies in each state should work under the direction of officials in charge of driver licensing, law enforcement, highway construction and maintenance, and possibly education. They should, however, be expected to keep in constant touch with the national agency, supplying the latter with copies of their studies and reports, and in turn making use of the resources of the central body.

The national agency would consist of a specially trained research staff working under some such federal agency as the Office of Defense Transportation (or its peacetime successor), or under a committee composed of such officials as administrators of federal agencies like the Office of Defense Transportation, the U. S. Public Roads Administration, the Interstate Commerce Commission, the National Resources Committee, and officers of national organizations of state officials like the American Association of Motor Vehicle Administrators, the International Association of Chiefs of Police, and the American Association of State Highway Officials.

The proposed national agency should be provided with adequate funds and with appropriate office and laboratory facilities to carry out research of the type discussed in the following section. When problems arise which require specialized assistance, the national agency should have the authority and funds to make use of the services of experts in related fields by the establishment of cooperative projects with universities and other research organizations.

The Functions of the Proposed Research and Planning Agencies

The national agency would be charged with (1) developing and keeping up to date an elastic master plan of national highway accident preven-

tion and (2) with conducting, supervising, and coordinating highway accident research throughout the country.

The research staff of the national agency would be expected to gather material for periodic surveys of highway accident prevention activities in the United States, and to serve as a national clearing house of scientific information about motor vehicle accidents. On the basis of the available facts and with the advice and approval of its policy making department head or advisory committee it could formulate a comprehensive authoritative plan for accident prevention activities on a national scale. As gaps in our knowledge were filled, and as new methods of accident prevention were developed, it would adapt its program to meet changing conditions. If it was supervised by a committee as previously described, those members representing various national organizations of state administrators would work to secure the backing of their respective associations in putting the national program into operation in the individual states.

The national agency would carry out special research projects from time to time and make the results available in reports to the individual states. It would also aid each state in initiating its own program and guide it, especially in the beginning. It would keep in close touch with state agencies and through summaries of the data furnished by individual states make available to all states the new facts and ideas. It would help to coordinate the activities of the separate states so as to bring them within the framework of a broad national plan of highway accident prevention.

The national agency would also give advice to federal agencies such as the United States Army and Navy, the Interstate Commerce Commission and others which have accident problems to solve.

These proposed national and state research agencies, however, would in no sense preempt the field of highway accident prevention research. Highway safety problems are so numerous and pressing that there will always be room for contributions from existing private safety organizations, universities, and research foundations for many years to come. The national agency could, however, render an important service by endeavoring to coordinate and to bring to the attention of public officials the results of the present scattered research.

An important duty of each state agency would be to take an inventory of the organizations carrying on highway accident prevention activities within its borders and outline the activities they are promoting. The details of such a survey will be discussed in one of the following sections.

Another major task of the state agency would be to recommend improvements in the reporting and recording of the state's accidents to provide a foundation for measuring improvement from year to year and to compare progress with that of other states.

In addition to these general functions the state agencies should be equipped to gather facts, carry out research, and render reports and recommendations on any problem relating to driver control and education given them by state administrators or state legislatures. They should be authorized to render information and advice to communities within the state on request.

SPECIFIC TYPES OF PROBLEMS TO BE SOLVED BY THE PROPOSED RESEARCH AND PLANNING AGENCIES

Since accident problems vary considerably from locality to locality and from time to time, it would be futile to try to lay out a fixed program for the nation as a whole or for the different states. Each research and planning agency would naturally adapt its activities to meet changing needs. It would select problems on the basis of their adequacy in helping the nation or the state to solve its difficulties. Its success would be determined largely by its serviceability in helping to reduce accidents within its jurisdiction.

But even though it is impossible to formulate a standard program, it is worth while to outline a number of research problems which national and state agencies might desire to undertake. Typical of such possible problems are the following:*

1. To make general surveys of driver safety activities and conduct a related information service describing them.
2. To study ways and means of improving accident records so as to measure safety progress accurately and fairly.
3. To investigate the causes of accidents and ways of counteracting them.
4. To determine the cheapest and most effective ways of reducing accidents with regard to the particular needs of the state and community.
5. To study how best to train and examine drivers.
6. To determine the most effective and constructive means of disciplining drivers.
7. To work out a system of detecting and re-examining violation- and accident-repeater drivers.
8. To gather facts about and carry out research on the drunken driver problem.
9. To study driver fatigue.
10. To develop ways and means of solving the pedestrian accident problem.
11. To investigate the causes of bicycle accidents.
12. To test the safety equipment of new vehicles.

* See also the suggestions in Chapter XV.

13. To determine standards for vehicle maintenance and the best means of enforcing them.

14. To aid in designing vehicles for safer operation.

15. To provide better material for safety publicity.

16. To study how to obtain more complete public support for accident prevention measures.

17. To formulate a simple convincing program of action.

General Surveys of Safety Activities and Information Service

Agencies throughout the nation which devote a part of their activities to driver accident prevention problems are numerous and represent a wide variety of interests. An attempt might be made to put to practical use those of their findings which offer real promise of help in solving our traffic safety problems. But first a survey of these agencies, both private and public, should be made to determine the nature of their activities.

It might be a function of the central accident prevention planning agency to keep an up-to-date file of all the organizations which deal with the problem of traffic safety, together with a summary of what they have contributed, and what they are trying to do. Such a central repository of information would help to prevent duplication of effort, and, by collating the work of different organizations, would discourage the distribution of the rather considerable amount of unsubstantiated opinion which passes for fact today.

The number and type of state agencies which contribute to accident prevention activities vary considerably from state to state. One of the first duties of a state research agency might be to look over the safety activities carried out by the different state departments and to sum up the advantages and disadvantages, from the standpoint of efficient accident prevention, of the prevailing locations of state driver control functions. For example, state accident records are variously located in the motor vehicle department, in the state police department, in the highway department, and in some states in a bureau disassociated with any of the above-mentioned departments. The research agency might study the situation and attempt to determine the best location for the accident records in the interests of all concerned.

In a genuine attempt to deal with the complex problem of driver accident prevention many legislators, governors, mayors, police chiefs, motor vehicle administrators, highway commissioners, and public-spirited citizens are continually advancing different schemes for its alleviation. It might be the duty of the proposed research agencies on request to make objective reports of all such recommendations. The state research agency

might make special studies for the legislature. It should, however, never permit itself to be involved in problems of politics or administrative policy, but stick to objective studies and reports.

Study of Ways and Means of Improving Accident Records and of Measuring Safety Progress

The collection and analysis of accident reports are poorly done in the majority of states and cities. Since the final goal of all safety activities is the reduction of accidents, it is essential to maintain an accurate and complete record of all fatal, personal injury, and serious property damage accidents in order to estimate the success of safety activities.

At present we are trying to catch up with Automobile Accidents, Incorporated, a racket costing us millions of dollars every year, with no adequate system to ferret out the villains so that we may convict them or cure them. More complete and uniform accident reporting would give us information which would enable us to direct our efforts far more wisely.

The central agency which we propose could assist the National Conference on Uniform Traffic Accident Statistics in carrying out preliminary research to aid it in the formidable task it has undertaken of formulating a satisfactory accident definition, a standard accident report form, and a standard form for summarizing state accident data. The central agency also might well stimulate different states to undertake special statistical studies of accidents aimed at discovering new and important relationships between accidents and their predisposing circumstances.

The state planning agencies might as their first task survey their states' existing systems of accident reporting and recording and make recommendations for bringing them into line with the practices recommended by the National Conference on Uniform Traffic Accident Statistics.

In Chapter VIII it was shown that various sociological and geographical factors cause variations in the accident rates of states independently of the amount of governmental regulation of the driver. It might be one of the responsibilities of a state agency to study the conditions peculiar to its locality which may prevent it from achieving results from the employment of safety regulations which have proven generally successful elsewhere.

By making available to the state agencies the results of regional accident surveys made in different parts of the United States and by furnishing them with comparative analyses of the accident data from all the states, the central agency could materially assist state authorities to view their own problems from a broader perspective. As a result of information gathered by the central office each state agency could be put in touch with other groups which had tackled and solved related problems and

could thereby be in a position to profit from the experiences of these other states.

The central agency might also attempt to devise more valid methods of measuring the safety standing of states and cities, giving due consideration to the wide variations in driving conditions which distinguish different localities. Perhaps eventually a system of handicaps making proper allowance for the considerable differences among states in the problems encountered in reducing accident rates can be worked out, permitting states to be more equitably ranked in safety status.

Investigation of the Causes of Accidents and Ways of Counteracting Them

A prerequisite to developing an efficient state program of accident prevention is a careful study of the most important causes of accidents within its jurisdiction. The highway accident problem is anything but simple. Only after careful studies of the variations in causes and types of accidents in different localities and under different conditions will state and city officials be able to envisage their local accident prevention problems clearly enough to cope with them successfully.

From the standpoint of the individual driver four of the most important variables which determine his accident susceptibility are exposure, speed, skill, and safety-mindedness (see Chapters II, III, IV, and V). Local planning agencies might properly gather information about some of the points raised in the following discussion of these four factors.

Study of Exposure. Although knowledge about the exposure of individual drivers is basic in evaluating their relative accident susceptibility, and the same is true of groups of drivers in communities and states, we have at present very few facts about variations in exposure among individuals and among groups. Fortunately we do have figures on the approximate total annual travel in states (see Chapter VII) and on the annual mileages of individual vehicles (see Chapter II).

Not only would further information about exposure furnish a better means of comparing individual drivers with drivers in general, and one particular community with other communities, but it would also give us a more complete understanding of the reasons why certain drivers, or certain communities, have better safety records than others, for exposure, as defined in Chapter II, includes not only the extent of travel but also the number and types of hazards encountered in traveling at different times and places. Valuable work could be done by both the central and local planning agencies in obtaining information about exposure that would be of service to responsible authorities.

Typical of research problems bearing on exposure and related factors which contribute to accidents are those suggested at the end of a cooperative research report on fatal accidents made by Earl L. Allgaier for the American Automobile Association and the Highway Research Board. [5, *375*]

Much of the time and money spent on the gathering of accident statistics which now only serve to confirm what is already known and accepted might be used more profitably in special studies of factors on which information is sadly lacking. We are particularly deficient in data on accident exposure under various circumstances. For the guidance of those interested in pursuing further some phases of traffic accidents several suggestions for further research are offered:

1. Interviews with pedestrians, who have been hit but survived, in order to obtain more information as to what they might have done to avoid it.
2. The miles driven per year for vehicles of various ages. Where inspection is required, taking speedometer readings at successive inspections would give a good deal of information (Washington, D. C. asks for this information when license plates are issued).
3. The prevalence of defects among vehicles of various ages.
4. The number of vehicles of each age registered. An analysis of registration would yield this information.
5. The relationship of the age of the car driven to the age of the driver.
6. The prevalence of defects among cars involved in accidents and other cars.
7. The relative number of miles driven by commercial and non-commercial vehicles for various days of the week and for various hours of the day. A count of traffic on the highway for various locations would give an approximate figure.
8. The relative number of vehicle miles for various hours of the day, various days of the week and various months of the year.
9. The relative amount of driving done by friends of the owner, relatives of the owner, employees of the owner, and the owner of the car himself.
10. The amount of driving done by men and women during the day and during the night. A count of traffic at several points would give some indication of the relative amount of driving done by the sexes.
11. The amount of driving done by the various age groups during the various hours of the day.
12. The partial correlation of accident records with age and experience of the driver to determine if it is age or experience which makes the record of young drivers so poor.
13. The percentage of operators over-driving their headlights for various age groups.
14. The percentages of the time various weather conditions prevail such as snow, rain, clear, cloudy, etc.
15. The relative number of pedestrians crossing the street at the various locations as in the crosswalk, in the middle of the block, with the green signal, etc.
16. Additional data on the relative percentage of pedestrians and drivers who have been drinking for the various hours of the day.
17. The prevalence of the various types of unsound walking practices among pedestrians of various age groups.
18. The number of persons riding in cars involved in fatal accidents to determine if the greater likelihood of a passenger being killed than a driver is due to the greater number of passengers involved.

Study of Speed. Speed too great for conditions is one of the most important causes of accidents. Unquestionably a drastic reduction of speed in a city or state will reduce accidents. But since a lowering of speed also tends to reduce the usefulness of the automobile as a means of rapid transportation, the enforcement of maximum speed laws will probably always represent a compromise between safety and convenience. What is reasonable in driving speed varies according to road conditions; time of day; and the experience, driving record, and attitude of the driver. We need much more information about the speed habits of different types of drivers under varying conditions before we can expect to use speed control intelligently in reducing accidents and at the same time retain the full convenience of the automobile. Speed studies represent a valuable type of investigation for the proposed driver research agencies to carry out.

In a special report on speed regulation and control on rural highways made under the auspices of the Highway Research Board, the following recommendations for such inquiry are made by Raymond G. Paustian: [224, *75*]

Extensive studies should be made of all factors relating to motor vehicle speeds on rural highways. Such studies should include factual surveys of speed practices, speed measuring equipment, methods of regulating motor vehicle speeds, and law enforcement methods and organizations.

The 20 specific studies suggested in the following list are typical of what needs to be done:

1. Improvements in rural-highway accident reporting with emphasis on presentation of data regarding vehicle speeds.
2. Human limitations to the operation of motor vehicles at high speeds.
3. The establishment of speed limits on the basis of observed vehicle speeds.
4. Trends in the top speeds of motor vehicles.
5. Feasibility of keeping commercial vehicles off trunk highways during week ends.
6. Speed characteristics of multiple-lane highways of both the divided and undivided type.
7. Costs of motor vehicle transportation at prevailing speeds on different road surfaces.
8. Time losses resulting from congestion on rural highways.
9. Conditions of motor vehicle lights and brakes.
10. Establishment of a night speed limit based upon the illumination provided by motor vehicle headlamps.
11. Reaction time and perception time of motor vehicle operators.
12. Highway signs designed for increased visibility under all conditions.
13. Merits and disadvantages of *prima facie* speed limits compared with absolute limits.
14. Use of the driver's license suspension to punish violators of traffic laws.
15. Public reaction to heavy penalties for exceeding speed limits.
16. Methods in handling traffic cases in the United States.
17. Degrees of observance in various classes of speed zones.
18. Public reaction to methods of regulating speeds on rural highways.
19. Equipment to determine safe speeds on curves.
20. Governors to regulate the speeds of motor vehicles.

Study of Driving Skill. We need: (1) a thorough analysis of the factors which go to make up driving skill; (2) a survey of the specific requirements necessary for driving various types of vehicles under different conditions; (3) improved apparatus; (4) better criteria for validating driver tests; and (5) a thorough grasp of all the variables affecting accident susceptibility.

We know little or nothing about the traits or characteristics which distinguish accident repeaters from accident-free drivers. Besides trying out heterogeneous assortments of tests, clinical diagnoses by psychologists, sociologists, and medical men are in order. In addition to sensory and motor performance, we need to know much more about personality traits, attitudes, and the physical and biographical backgrounds of drivers.

The requirements for driving different vehicles such as passenger cars, commercial trucks, buses, taxicabs, and army trucks under different circumstances vary widely. Thus a man who is a first-class taxi driver may make a third-rate Army truck driver. We need to make careful job analyses of the requirements for driving different types of vehicles under different conditions of exposure.

Far more work is needed in improving the more promising types of tests, and in devising new pieces of apparatus to measure hitherto neglected abilities involved in driving. The use of the motion picture in testing drivers is particularly to be commended.

The criterion employed in validating a test is of vital importance in determining the results. We need to develop better criteria of safe driving ability than the incomplete and undependable accident records used in most past investigations.

We should always keep in mind that accident susceptibility depends upon a number of other factors besides native ability or skill, such as exposure, age, experience, driving speed, and safety-mindedness. Such variables must be controlled, or else allowed for when studying driving skill.

Study of Safety-Mindedness. One of the most important characteristics of the safe driver is a composite attitude which for want of a better term has been referred to as safety-mindedness. A thorough investigation of safety-mindedness might properly be one of the most important concerns of the national research agency and its local representatives. We need to know not only the general characteristics (both mental and emotional) of the less capable and accident-prone drivers, but also the temporary mental states and attitudes which contribute to the occasional accidents of normal drivers. And since safety-mindedness seems to vary according to the locality and to the types of people concerned, it is highly desirable that sufficient thought be devoted to the problem of adapting

our safety education programs to meet the particular needs of those types of individuals and those groups most inclined to incur accidents.

Research to Determine the Most Effective Accident Prevention Methods

Our lack of consistent and uniform progress in accident reduction is indicative of ineffective methods of attack. Thus some states are inclined to devote the lion's share of their efforts and funds to police enforcement of traffic rules to the exclusion of needed driver regulation and educational activities. Other states give unstinted support to the emergency-type safety campaign such as those featuring displays of safety posters, fatality thermometers, or newspaper appeals, while neglecting the training, examining, and proper disciplining of their drivers. Both states and cities are often inclined to promote one-sided safety programs which originate in the sincere but entirely unsubstantiated opinion of some prominent official. The availability of a state planning agency would discourage this all-too-common practice of an injudicious choice of a plan of attack by providing facts upon which to formulate a sound well-balanced program.

All the suggested accident prevention activities mentioned in previous chapters of this book must be adapted to fit the requirements of the particular state or city desiring to use them. State safety agencies, which nearly always have far too little money, can secure optimum results only by carefully studying the particular problems confronting them, planning ahead intelligently, and then periodically checking their progress or lack of it.

The ability of an administrator to carry out the duties of his office efficiently is naturally dependent on the availability of adequate funds. In order to justify pleas for additional appropriations, an administrator must be able to prove conclusively that he has employed his available funds prudently and effectively. The services of a research and planning agency would be a godsend to safety administrators by furnishing them with facts and figures to back up their reports of progress and proposals for expenditures in the future.

Training and Examining Drivers

It is generally agreed that normal physique and mentality are necessary characteristics of those persons licensed to drive automobiles. To these qualifications must be added knowledge about driving and traffic conditions, enough experience at the wheel of a car to ensure reasonably capable handling of it on the road, and a responsible attitude. In order,

therefore, to sift out those persons who are unsuited or insufficiently experienced to drive a car, it is desirable to require all persons who want to drive to submit to a qualifying examination before issuing them licenses. The examination serves two main purposes: that of eliminating the unfit and of requiring beginners to practice driving and to learn the rules of the road. Naturally the stiffer the license examination the more fit must be the successful applicant, and the more thorough his training.

The American Association of Motor Vehicle Administrators has approved a uniform, efficient driver examination procedure and has recommended its adoption by every state. Even after the adoption of such a standard examination, however, it may take years before all examiners are trained to carry out their duties consistently. State accident research agencies might properly perform a useful service in connection with this problem. They would do well to investigate the subsequent accident records (with due regard to their exposures) of the applicants passed by different examiners to discover which examiners consistently graduate good drivers, and which turn loose on the road many poor ones.

Very little evidence has been adduced to prove the effect of driver training on subsequent accident records (see Chapter XIII) and no effort has been made to study the relative effectiveness of different methods of instruction and of different driver-training agencies. The state research agencies could render an invaluable contribution toward improving driver-training courses if they were to gather data of this sort. Since high schools are training only a small proportion of the total number of license applicants, there is a need for states to consider the advisability of sponsoring public driver-training courses. A suitable task for the national research agency might be to appraise this idea and determine the advantages of state-operated driver-training programs. Possibly the need for publicly sponsored driver training varies considerably from state to state.

Disciplining and Re-Educating Drivers

Proper enforcement, i.e., the apprehension of violator and accident drivers and their appropriate treatment, is essential to any well-rounded accident prevention program.

Studies such as the following are needed: (1) to determine how many accidents could be prevented by increasing the size of the highway patrol in urban and rural states, or by distributing the available patrol more efficiently; (2) to ascertain to what extent increasing the number of warnings issued and arrests made affects the number of accidents; and (3) to discover how to retain the backing of the public while enforcing the traffic laws strictly.

In spite of a rising sentiment for adopting more constructive measures for dealing with traffic offenders, there is little concrete evidence to show what specific measures should be used, and how much they would help if employed. An important study for the proposed research agency would be to gather facts about various types of penalties and evaluate their deterrent effects on the basis of the extent of subsequent repetition of offenses by the drivers concerned. The results of such studies would furnish the basis for a revision of our present somewhat outmoded methods of handling traffic offenders.

Another promising type of research activity would be to study the effectiveness of different types of rewards. On this question there are practically no data, in spite of the favorable possibilities of good results from some system of rewarding operators who continue to drive year after year without accidents.

Detection and Re-Examination of Violation- and Accident-Repeater Drivers

There are three phases to the problem of handling bad drivers: (1) to find out who they are; (2) to discover just what is wrong with them; and (3) to re-educate them or take them off the road. At the present time we have hardly made a beginning at these tasks of discovering, analyzing, and curing or getting rid of incompetent drivers, in spite of the fact that studies have shown that a small group of such drivers cause a disproportionately large percentage of all accidents (see Chapter IX).

A state research agency could do much towards advancing the solution of the violation- and accident-repeater problem by picking out a group of such drivers, subjecting them to a variety of clinical examinations and educational procedures, and following up their records to determine the effect of the different types of treatment on their subsequent driving careers. Further data on this important subject would aid materially in encouraging states to institute suitable treatment for repeaters. The present custom of allowing incapable drivers unrestricted opportunity to commit more violations and incur more accidents presents an unwarranted hazard to other drivers.

The scope and types of desirable re-examinations, their costs, the results to be expected, and the anticipated public reaction, are topics to be studied in a thorough-going appraisal of the problem of re-examining and re-educating repeater drivers.

Study of the Drunken Driver Problem

In those states where the drunken-driving problem is serious, a valuable project for a research agency would be to gather data on the types of persons apprehended for drunken driving, the quantity of alcohol their blood contained, and the correlation of this percentage of alcohol with their motor coordination and ability to handle their vehicles safely. Collection of facts of this nature would be of considerable value to judges and motor vehicle administrators in developing procedures for handling drunken drivers more effectively.

Study of Driver Fatigue

The pioneering study of the U. S. Public Health Service on fatigue and hours of service of interstate truck drivers has emphasized an important field for research which has received little attention. Because much valuable work remains to be done, however, in the development and use of performance tests of drivers' fatigue and in the control of those factors it is difficult to estimate the part played by fatigue in causing motor vehicle accidents. Careful accounts should be kept of the relation of hours of driving to accidents, both among passenger car drivers as well as truck drivers.

Study of the Pedestrian Accident Problem

An intensive study of pedestrian accidents has yielded a wealth of information about the characteristics of pedestrians who have been killed (see Chapter X), but little has been done to educate the public to walk safely, with the exception of the excellent work done in primary grades. Since the pedestrian problem varies considerably from place to place, localized research is necessary, particularly in cities, where most pedestrian accidents occur, to help the local authorities choose the most effective, inexpensive, and least inconvenient methods of controlling the movement of persons on foot. Studies are also needed to determine the best methods of educating the driver to avoid hitting pedestrians. All these studies could well be undertaken by individual state accident prevention research agencies.

Study of Bicycle Accidents

The doubling of the number of bicycle deaths in the last eight years emphasizes the need for a careful survey of the circumstances surrounding

bicycle accidents as a foundation for a program to teach our bicyclists and motorists to avoid collisions. After carrying out the necessary fact gathering, it will be desirable to try out different methods of approach to both the motorist and the bicyclist to discover which are most effective in reducing this type of accident.

Testing the Safety Equipment of New Vehicles

A number of states make a practice of testing the safety equipment, such as lights and brakes, of new models of motor cars, as well as replacement and accessory safety equipment sold by dealers. The national highway accident research agency could make a worthy contribution to safety by providing facilities for testing new safety equipment and by rendering reports to each state of their findings. In this way those states which are at present unable to conduct their own tests would be benefited while the needless duplication of effort caused by states maintaining their own laboratories would be eliminated.

Improving Vehicle Maintenance

Although there is a growing trend toward requiring owners to bring their vehicles in for periodic state inspection, there is a dearth of clear-cut evidence to show to what extent and in what ways vehicle inspection actually influences the accident record of a state. A suitable problem for a research agency in a state with such a vehicle inspection system would be to compare the accident records of cars which consistently come in for inspection in bad repair, with those of cars which always appear in fine shape for inspection. A parallel study would be to investigate the effect of vehicle age on maintenance.

Improving the Design of Vehicles for Safer Operation

Steady progress has been made in improving the structural safety, mechanical operating efficiency, comfort, and appearance of modern automobiles. But the question of operating safety has received less attention than it deserves both with regard to trucks and buses and passenger vehicles (see Chapter XI). As J. Willard Lord of the Atlantic Refining Company says:

> A truck can be a beautiful piece of engineering and stand up under the most severe use, but at the same time its design can be such that it is the very devil to drive, fatiguing to operate, difficult to maintain, disliked by drivers and mechanics, and frequently involved in accidents. [160, *1*]

The proposed national accident research agency might stimulate progress in this field by bringing together fleet supervisors, motor vehicle administrators, traffic police commissioners, and automotive engineers and designers in a cooperative attack on improving vehicles from the angle of safe operation.

Supplying Material for Safety Publicity

Many of the findings of the research and planning agencies would furnish an excellent foundation for a higher type of publicity than the melodramatic variety of safety propaganda so common today. The research agency could also furnish public officials with a valuable supply of interesting information about recent developments in accident prevention which would help them in convincing the public of the need for more progressive administrative practices.

Obtaining Public Support for Driver Safety Measures

Even the most scientific and factually substantiated of highway safety programs cannot succeed without public support. Hence no safety research plan would be complete unless it provided for improving the relations between the officials in charge of accident prevention activities and the general public.

A number of state safety administrators have succeeded remarkably well in enlisting public support for safety activities (see Chapter XV). It would be profitable to have summarized in some detail the experiences and practices of these successful public officials in the form of a handbook for administrators.

Such a guide, after outlining the history of motor vehicle and police traffic administration in the United States and reviewing its accomplishments, would go into the form of public policy and the most effective types of preventive activities which an administrator must employ if he is to achieve the most in his field.

A state motor vehicle or safety commissioner has a unique job in that he must induce the public to take medicine for its own good. He is a public servant who must sell the legislature, the governor, and, most important of all, the public innovations in traffic and driver control, many of which take the form of restrictions. To do this he must make himself a person of prominence in the state, whose opinions and actions are respected, and he must know how to induce others to go along with him. He must convince the driving public, which in this country is practically all the public, that he is fighting for their welfare, even if he must buck

the political powers-that-be. He must get others to recognize the wisdom of his course and convert them to his way of thinking.

The majority of state safety directors unfortunately remain in office only two or three years, to be followed by new incumbents who generally have had no previous training for their work. If some such guide as we are suggesting, which would summarize the practices of successful administrators, were available to fledgling administrators, they would be shown how to avoid costly mistakes in their relations with the public and would be in a better position to resist their rapid turnover, which causes so much disorganization in state accident prevention programs. Such a guide would be equally useful to legislators, and would aid in enlisting their support for the needed fact-finding and planning activities.

Formulation of a Simplified Convincing Program of Action

Under a dictatorial form of government where public officials do not account to the public for their actions they may base their policies on guesses. But in a democracy where public officials may be held accountable for waste or inefficiencies resulting from poor administration, they cannot afford to depend so much on intuitions.

Public officials need sources of information to provide them with material upon which to base intelligent decisions. In no field is this more requisite than in that of highway safety. Far too little practical research is carried out on important matters relating to public administration in the United States, and where it is done, the results are not always as satisfactory as we might have hoped for. For example, the fate of many national research and planning programs in this country is that they grow increasingly more complicated and often end by confusing both the administrative and the public comprehension of the problem studied rather than by simplifying it. Since the results of social research must be inculcated in the habits of thought and action of the mass of our population before this research can do any good, the proposed highway safety program must avoid this pitfall of unnecessary complication through the unending multiplication of problems. Research and planning on automobile accident prevention should not be allowed to become ends in themselves but should remain tools for the ultimate formulation of a simple, cheap, easily comprehensible, and convincing accident prevention program.

SOME MISTAKES TO AVOID IN THE PROPOSED PROGRAM

In a democracy effective research on a public administration problem like highway accident prevention has a dual task. Besides gathering facts and making discoveries it must present its results and recommendations in reports which will convince both governmental officials and the public that they are reports which should be acted upon. For only after the public and its accredited authorities are persuaded will the research agency be sure of obtaining the action indicated by its accomplishments. Proper attention should therefore be devoted to selecting a suitable staff, and to administering the research and planning agency in such a way as to ensure that it will put out convincing reports.

Much present-day research is wasted because of casual selection of problems, or because the results of the research fail to carry conviction. For example, a considerable amount of the research carried out in our universities is of little consequence to society because it is directed toward problems which fail to solve present-day needs or appeal to present-day interests. And much of the really valuable social science research in universities is relegated to an early burial on the forgotten shelves of libraries because being couched in unnecessarily technical and obscure language it fails to attract the attention of the public or of those persons with authority to act on its findings.

Fortunately highway accident research is not only of great importance, but timely, socially significant, and of interest to the public and to public officials. Possibly its practicality is one of the reasons it has been generally shunned by universities, many of which pride themselves on their devotion to "pure" research.

The most threatening causes of failure of the proposed highway accident prevention research program would lie in the well recognized weaknesses which characterize governmental administration, such as poorly trained and inadequately paid personnel and an overexaggerated interest on its part in the perpetuation of its work, rather than in solving the problems at hand.

It will be necessary therefore to offer adequate salaries to attract high-caliber men to the staff of the national research and planning agency, and to insist that the goal of the staff is to obtain convincing proof of the simplest, most efficient and cheapest ways of reducing accidents. The group would be expected to complete a succession of tasks leading toward the goal of solving the problem of highway accidents and likewise toward the elimination if possible of the need for further research on the problem. Government research can be just as efficient as university and industrial

research if those doing it are as carefully picked and the program managed with the same intelligence as is customary in our best private industrial or university research laboratories. Particularly needed in governmental quarters is emphasis upon research as a tool for solving definite problems, rather than as a means of perpetuating the research agency itself.*

THE ACCIDENT PREVENTION RESEARCH AND PLANNING PROGRAM A FEDERAL PROJECT

America has long needed federal coordination of highway transportation, including coordination of all activities. The recent appointment of Joseph B. Eastman, who is also Chairman of the Interstate Commerce Commission, to head an Office of Defense Transportation represents a most important forward step toward the goal of a unified national system of transportation. And no better qualified man for this position could have been found than Mr. Eastman, with his wide experience as Chairman of the Interstate Commerce Commission. The choice of John L. Rogers, also a member of the Interstate Commerce Commission, to head the Division of Motor Transport in this new organization is a particularly happy one, for Mr. Rogers has for several years specialized in the highway transport phase of the Commission's regulation of interstate commerce.

The Office of Defense Transportation will have charge of coordinating all highway, rail, airway, waterway, and pipeline services in the United States. In wartime it will be expected to keep troops and war supplies moving with a minimum of delay especially at congested seaports and strategic centers. It will have authority to coordinate the transportation policies and activities of all federal regulatory agencies to control civilian traffic movements and, if necessary, power to curtail these by embargoes or priorities.

It would seem logical for the Office of Defense Transportation to sponsor or help initiate highway accident research, for a reduction in highway accidents would facilitate the flow of traffic and conserve unnecessary waste of life and destruction of property. In fact since highway transportation is so vitally important to our American way of life it would seem that any plan for improving our national transportation system would include highway accident prevention as an outstanding feature.

Another organization which might sponsor the proposed planning program is the National Highway Traffic Advisory Committee. This group is composed of representatives of the U. S. Public Roads Administration, the American Association of Motor Vehicle Administrators, the Interna-

* See *Research a National Resource* [198] for a survey of research by federal departments with recommendations for improving it.

tional Association of Chiefs of Police, and the American Association of State Highway Officials. Thomas H. MacDonald, U. S. Commissioner of Public Roads, is chairman, and Leland S. Harris, Executive Director of the American Association of Motor Vehicle Administrators, is secretary. The Committee was formed for the purpose of enlisting the assistance of motor vehicle, highway, and police officials throughout the nation in cooperating with the Army in working out solutions to the many highway traffic problems occasioned by the defense program.

Cooperating with this central committee are state committees composed of the motor vehicle commissioner, police commissioner, highway commissioner, and education commissioner of each state. These committees help to facilitate wartime traffic activities such as the passage of Army convoys through the state; the collection of information concerning the location of all trucks, buses, and other motor vehicles which might be needed by our armed forces in case of emergency, and the transmission of accident information on Army drivers when requested.

If the existing National Highway Traffic Advisory Committee and its associated state committees could be placed upon a permanent basis, and if their functions were broadened, they would represent an ideal type of organization to administer the research and planning activities outlined in this chapter. General supervision of the conduct of such research activities and promotion of the findings therefrom could likewise be undertaken by this national committee, which has brought together for the first time in every state those important officials and organizations whose cooperation and support are essential to the success of a systematic highway safety planning program of national scope.

A few state legislatures have already passed bills giving the state traffic advisory committees official status; others have felt that ample legal authority was already available. The National Committee believes that effective work in peacetime can be assured only if legal status is secured in all states. This will permit the functioning of state committees throughout the whole field of highway transportation, and will permit wherever necessary the allocation of funds to accomplish the committees' objectives.

As Chairman of the central committee, Commissioner MacDonald points out:

> These committees represent the most effective group ever organized to facilitate and to control highway transport. Their effectiveness need be in no way diminished after the emergency passes; in fact it is only then that their true value will become apparent. . . . Although the existence of the emergency unquestionably is responsible for the creation of these State Committees, the field for action is not limited by the emergency. It includes particularly for the motor vehicle administrators an unparalleled opportunity for research

especially along the lines developed by the driver research committee of the American Association of Motor Vehicle Administrators. . . . After the emergency passes, and even during the emergency, work must be continued on the driver behavior studies along the lines developed in the cooperative work between the Institute of Human Relations and the Public Roads Administration. . . . Unquestionably, regardless of the merits or defects of highway design and construction, the greater the discipline we can instill in drivers, the safer will be our highways.

The national emergency has definitely changed our too complacent viewpoint of our highway facilities. It should also inspire us to review more critically many other matters, particularly the traffic accident situation. An opportunity is presented that we cannot afford to let pass. A program of coordinated effort must be developed that will be continued and perfected upon our return to more normal conditions. [167, *9*]

The availability resulting from the emergency of federal organizations to coordinate transportation, plus the general awareness and appreciation on the part of federal and state officials of the need for research and fact gathering as an indispensable prerequisite for improving the efficiency of highway traffic, presents an opportunity for the initiation of this needed approach to the costly accident problem which should not be missed.

OUR HIGHWAY ACCIDENT PROBLEM IN BRIEF

Conservation of life, limb, and property on our highways is vital to our national welfare. But present modes of coping with accidents by issuing proclamations, passing laws and resolutions, and promoting safety campaigns, although these may be helpful, are falling behind the demands of the situation. Highway accident prevention is an exceedingly complex problem which requires for its solution far more systematic thinking and concerted effort, and a much more generous expenditure of funds than are being allotted to it.

Its Importance

On account of its speed, comfort, flexibility, and relatively low cost, automotive transportation has contributed materially to the development of our natural resources and to the maintenance of our democratic national unity. Although we Americans have eagerly utilized the numerous advantages the automobile offers, we have shown little inclination to eradicate the accidents which have increased more or less unrestrictedly with the growth of automotive transportation. Unfortunately, since cars are now so numerous and their combined mileages so extensive, the loss to our national resources from casualties, which amount to hundreds of

thousands, and from damages, which run into millions of dollars, can no longer be treated so lightly.

Its Complexity

For years we have tried various makeshift solutions to decrease automobile accidents, without much success, as our failure to reduce these accidents consistently has shown. It is high time that we gave up the use of panaceas and casually conceived measures and insisted upon the development of a long-range comprehensive national program adequate to deal with the problem in all its complexities.

Its Cost

We have let our highway accident problem go so long and become so serious without our tackling it in earnest, that we cannot expect now to solve it quickly and inexpensively. The needed program of driver improvement and control outlined in this book cannot be carried out efficiently on a national scale without the expenditure of considerable sums of money. E. W. James of the U. S. Public Roads Administration estimates that the cost of an adequate nation-wide program of training and examining drivers, collecting, recording, and analyzing accident reports, inspecting vehicles, and improving highway patrols would come to approximately $169,000,000 * annually. [131, *441*] By standards of war expenditure this is a trifling amount of money. But even by peacetime standards it seems reasonable when we consider that the direct costs of motor vehicle accidents to the nation as a whole are estimated to amount to over $1,000,000,000 per year. [201, *65*] The five-dollar-per-year federal tax imposed on each motor vehicle in February, 1942, raises approximately $160,000,000 annually. If this tax were continued after the war and applied to accident prevention it would furnish enough money to defray the expenses of a real attack on the accident problem.

Intelligent Planning Required for Its Solution

In view of the magnitude of the highway accident problem, its complexity, and the high cost of its solution, it is essential that we achieve

* This figure does not represent total new expenditures, but rather the total estimated cost of all government agencies carrying on these services with reasonable efficiency. Such funds as are now devoted to these activities by the various states are included in this total cost.

maximum results from the money appropriated for its eradication. Proper provision must therefore be made for long-range planning.

Who should do the planning? Obviously not private agencies, but rather the federal and state governments as representatives of the citizens using the highways. And if we expect to handle the job in a businesslike and efficient manner we should be prepared to offer compensation and tenure of office attractive enough to draw into this type of public service our best talent.

Who should pay for the planning? In the beginning, at least, the lion's share of the expense should be borne by the federal government. This is essential if we are to provide for a nation-wide survey of highway accident prevention activities and their accomplishments, a step necessary for obtaining facts upon which to build up-to-date, economical, and effective action programs in the different sections of the country.

NEED FOR ACTION

The thousands of persons destined to die on our American highways each coming year and the hundreds of thousands of persons slated to be injured there will not be spared unless intelligently planned and effective cooperative measures—in contrast to present-day casual, piecemeal attacks—are instituted by our governmental authorities to prevent the accidents in which these unfortunates will be the victims.

No time could be more opportune for attempting to remould our accident prevention program than the present. If efficient education and control measures could be inaugurated now when the American public is in a mood to take orders readily, there would be considerable likelihood that such measures would have proved their value by the time the war is over and our willingness to submit to restrictions on our individual liberties has waned. The presence of the emergency, moreover, gives us more reason than ever before for adopting effective measures for controlling the accidents which interfere with efficient transportation, so vital in modern total warfare.

Who can initiate these necessary measures? The responsibility for leadership in obtaining action lies with such officials as the Director, Office of Defense Transportation; U. S. Public Roads Commissioner; Chairman, National Resources Planning Board; the officers of such bodies as the American Association of Motor Vehicle Administrators, the International Association of Chiefs of Police, and the American Association of State Highway Officials; and automobile, petroleum, and insurance executives. Whether we shall continue to allow this needless loss of our human and material resources on American highways is for these individuals

and for our leaders in Washington to decide. By the 1936 Highway Act authorizing the expenditure of federal funds on highway research and planning, Congress laid the foundation for a rational program of road development. Only by our federal government providing funds for similar nation-wide research and planning on highway accident prevention, and for translating planning into action lies much hope for the early solution of our automobile accident problem.

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